RETURN TO CD-ROM TABLE OF CONTENTS

North
American
Dräger

Dräger

Operator's Instruction Manual

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Narkomed 2B
Anesthesia System

RETURN TO CD-ROM TABLE OF CONTENTS

RETURN TO CD-ROM TABLE OF CONTENTS

Narkomed 2B
Operator's Instruction Manual

Table of Contents

Section 1: Introduction

Operator's Responsibility for Patient Safety 1-1
Limitation of Liability 1-2
Restriction 1-2
Symbol Definition 1-2
How This Manual Is Organized 1-3
Conventions Used in This Manual 1-4
General Warnings and Cautions 1-4
Recommendations 1-5

Section 2: General Description

Overview 2-1
Gas Delivery System 2-1
Vaporizers 2-11
Absorber 2-12
Bain Circuit Adapters 2-15
Scavenger Systems 2-17
AV2+ Ventilator 2-19
Main Switch Panel 2-20
Power Supply System 2-22
System Interface Panel 2-24
Monitoring System 2-25
Alarm System 2-26
Manual Sphygmomanometer 2-27
O.R. Data Manager® 2-28

Section 3: Daily Checkout

Daily Checkout Procedure 3-1

Section 4: Preuse Checkout

Preuse Checkout Procedure 4-1

Section 5: Operation

Gas Delivery System
- Overview 5-1-1
- Connecting the Pipeline Gas Supply 5-1-1
- Connecting the Gas Cylinders 5-1-2
- Connecting the Fresh Gas Hose 5-1-4
- Adjusting the Gas Flow 5-1-4
- Using the Oxygen Flush 5-1-4

Narkomed 2B
Operator's Instruction Manual

Table of Contents

Vaporizer
- Overview . . . 5-2-1
- Filling Systems . . . 5-2-1
- North American Dräger Exclusion System . . . 5-2-2
- Operating the Vaporizers . . . 5-2-3
- Filling the Vaporizer . . . 5-2-4
- Filling the Vaporizer During a Case . . . 5-2-5
- Draining the Vaporizer . . . 5-2-11

Absorber System
- REFER TO SEPARATE MANUAL . . . 5-3-1

Bain Circuit Adapter
- REFER TO SEPARATE MANUAL . . . 5-4-1

Open Reservoir Scavenger
- Overview . . . 5-5-1
- Connecting the Open Reservoir Scavenger System . . . 5-5-2
- Operating the Open Reservoir Scavenger System . . . 5-5-3

Scavenger Interface for Passive Systems
- Overview . . . 5-6-1
- Operating the Scavenger Interface for Non-active Systems . . . 5-6-2

Main Switch Panel
- Overview . . . 5-7-1
- System Power Switch . . . 5-7-1
- Testing the Battery . . . 5-7-2

AV2+ Anesthesia Ventilator
- Overview . . . 5-8-1
- Activating the Ventilator . . . 5-8-2
- Adjusting the Tidal Volume . . . 5-8-4
- Setting the Respiratory Frequency . . . 5-8-4
- Setting the Inspiratory/Expiratory (I:E) Phase Time Ratio . . . 5-8-5
- Setting the Inspiratory Flow Rate . . . 5-8-5
- Setting the Inspiratory Pressure Limit . . . 5-8-5
- Problem Resolution . . . 5-8-6

Monitoring System
- Overview . . . 5-9-1
- Power-On Screen . . . 5-9-1
- Monitor Screens and Controls . . . 5-9-2
- Configuring the Anesthesia Machine . . . 5-9-4
- Controlling Continuous Audible Alarms . . . 5-9-6
- Working with Trace Data . . . 5-9-7
- Working with Trend Data . . . 5-9-8
- Working with Numerical Data . . . 5-9-10

Table of Contents

Oxygen Monitoring
- Overview . . . 5-10-1
- Monitor Displays . . . 5-10-2
- Monitor Controls . . . 5-10-3
- Setting Alarm Limits . . . 5-10-4
- Calibrating the Oxygen Sensor . . . 5-10-5
- Unsuccessful Calibration . . . 5-10-7
- Oxygen Alarm Messages . . . 5-10-9
- Low Oxygen Supply Whistle . . . 5-10-10
- Problem Resolution . . . 5-10-11

Respiratory Volume Monitoring
- Overview . . . 5-11-1
- Monitor Displays . . . 5-11-2
- Monitor Controls . . . 5-11-3
- Setting the Minute Volume Low Alarm Limit . . . 5-11-4
- Controlling Volume Alarms . . . 5-11-4
- Respiratory Volume Alarm Messages . . . 5-11-5
- Problem Resolution . . . 5-11-7

Breathing Pressure Monitoring
- Overview . . . 5-12-1
- Choice of Breathing Pressure Monitoring Location . . . 5-12-1
- Installing the Breathing Pressure Pilot Line . . . 5-12-2
- Monitor Displays . . . 5-12-4
- Monitor Controls . . . 5-12-6
- Setting the Pressure High Alarm Limit . . . 5-12-6
- Setting the Threshold Pressure Alarm Limit . . . 5-12-7
- Controlling the Apnea Alarm . . . 5-12-9
- Breathing Pressure Alarm Messages . . . 5-12-10
- Problem Resolution . . . 5-12-11

Manual Sphygmomanometer
- Overview . . . 5-13-1
- Selecting a Blood Pressure Cuff . . . 5-13-2
- Connecting the Cuff . . . 5-13-2
- Placing the Cuff . . . 5-13-3

Section 6: Cleaning and Routine Maintenance

Overview . . . 6-1
Routine Maintenance . . . 6-1
Removing Parts for Cleaning and Disinfection . . . 6-7
Disassembling Parts for Cleaning and Disinfection . . . 6-10
General Guidelines for Cleaning and Disinfection . . . 6-12
Reassembly Instructions . . . 6-19

Narkomed 2B
Operator's Instruction Manual

Table of Contents

Section 7: Specifications

General 7-1
Environmental 7-1
Electrical 7-1
Gas Delivery System 7-2
Vaporizers 7-3
Ventilator 7-3
Absorber System 7-3
Oxygen Monitoring 7-4
Breathing Pressure Monitoring 7-4
Respiratory Volume Monitoring 7-4
Serial Interface 7-5

Appendix - Spare and Replacement Parts A-1

Index I-1

Section 1
Introduction

Operator's Responsibility for Patient Safety

North American Dräger anesthesia products are designed to provide the greatest degree of patient safety that is practically and technologically feasible. The design of the equipment, the accompanying literature, and the labeling on the equipment take into consideration that the purchase and use of the equipment are restricted to trained professionals, and that certain inherent characteristics of the equipment are known to the trained operator. Instructions, warnings, and caution statements are limited, therefore, to the specifics of the North American Dräger design. This publication excludes references to hazards which are obvious to a medical professional, to the consequences of product misuse, and to potentially adverse effects in patients with abnormal conditions. Product modification or misuse can be dangerous. North American Dräger disclaims all liability for the consequences of product alterations or modifications, as well as for the consequences which might result from the combination of North American Dräger products with products supplied by other manufacturers if such a combination is not endorsed by North American Dräger.

The operator of the anesthesia system must recognize that the means of monitoring and discovering hazardous conditions are specific to the composition of the system and the various components of the system. It is the operator, and not the various manufacturers or suppliers of components, who has control over the final composition and arrangement of the anesthesia system used in the operating room. Therefore, the responsibility for choosing the appropriate safety monitoring devices rests with the operator and user of the equipment.

Patient safety may be achieved through a variety of different means depending on the institutional procedures, the preference of the operator, and the application of the system. These means range from electronic surveillance of equipment performance and patient condition to simple, direct contact between operator and patient (direct observation of clinical signs). The responsibility for the selection of the best level of patient monitoring belongs solely to the equipment operator. To this extent, the manufacturer, North American Dräger, disclaims responsibility for the adequacy of the monitoring package selected for use with the anesthesia system. However, North American Dräger is available for consultation to discuss monitoring options for different applications.

Section 1
Introduction

Limitation of Liability

North American Dräger's liability, whether arising from or related to the manufacture and sale of the products, their installation, demonstration, sales representation, use, performance, or otherwise, including any liability based upon North American Dräger's product warranty, is subject to and limited to the exclusive terms of North American Dräger's limited warranty, whether based upon breach of warranty or any other cause of action whatsoever, regardless of any fault attributable to North American Dräger and regardless of the form of action (including, without limitation, breach of warranty, negligence, strict liability, or otherwise).

North American Dräger shall in no event be liable for any special, incidental, or consequential damages (including loss of profits) whether or not foreseeable and even if North American Dräger has been advised of the possibility of such loss or damage. North American Dräger disclaims any liability arising from a combination of its product with products from another manufacturer if the combination has not been endorsed by North American Dräger. Buyer understands that the remedies noted in North American Dräger's limited warranty are its sole and exclusive remedies.

Furthermore, buyer acknowledges that the consideration for the products, equipment, and parts sold reflects the allocation of risk and the limitations of liability referenced herein.

Restriction

Federal law restricts this device to sale by, or on the order of, a physician.

Symbol Definition

The following symbols appear on the label on the back of the Narkomed 2B and are defined below.

CAUTION: Refer to accompanying documents before operating equipment.

ATTENTION: Consulter les documents ci-joints avant de faire fonctionner l'apparail.

CAUTION: Risk of electric shock, do not remove cover. Refer servicing to a North American Dräger qualified technical service representative.

ATTENTION: Risque de choc electrique, ne pas enlever le couvercle. Ne faire reparer que par un representant technique autorise de North American Dräger.

Degree of protection against electric shock: Type B.
Protection contre le risque de choc electrique: Type B.

These additional symbols are used on other locations of the Narkomed 2B to provide quick and easy recognition of product functions.

OXYGEN CONCENTRATION

BREATHING PRESSURE

BREATHING VOLUME

AUDIBLE ALARM DISABLE

AUDIBLE ALARM ENABLE

THRESHOLD PRESSURE ALARM LIMIT

How This Manual Is Organized

All users of the Narkomed 2B must read this manual completely before using the machine. In order to make this document more convenient for future reference, it has been divided into several independent sections.

“Section 2 - General Description” provides a summary of Narkomed 2B features and functions.

“Section 3 - Daily Checkout” contains the checkout procedures that must done on a daily basis.

“Section 4 -Preuse Checkout” contains the checkout procedures to be performed between successive cases.

“Section 5 - Operation” provides detailed instructions on the use and operation of each functional component of the system.

“Section 6 - Cleaning and Routine Maintenance” provides cleaning, maintenance, and replacement procedures.

“Section 7 - Specifications” contains the specifications for all system components.

Section 1
Introduction

Conventions Used in This Manual

This manual has been set up with several conventions to help organize the information contained in it. Please read about these conventions carefully so that you understand their significance in the manual.

Typefaces

Different typefaces are used throughout the manual to differentiate between narrative information and machine messages and labels.

Warnings and Cautions

All parts of this manual contain warning and caution statements about the Narkomed 2B.

- *Warning* statements give important information that, if ignored, could lead directly to a patient's injury.
- *Caution* statements give important information that, if ignored, could lead directly to equipment damage and, indirectly, to a patient's injury.

General Warnings and Cautions

The following list of warnings and cautions apply to general operation and maintenance of the Narkomed 2B. Warnings and cautions about installing and operating specific parts appear with those topics.

WARNING: Any person involved with the setup, operation, or maintenance of the Narkomed 2B anesthesia system must be thoroughly familiar with this instruction manual.

WARNING: This anesthesia system will not respond automatically to certain changes in patient condition, operator error, or failure of components. The system is designed to be operated under the constant surveillance and control of a qualified operator.

WARNING: No third-party components shall be attached to the anesthesia machine, ventilator, or breathing system (except for certain approved exceptions). Contact the North American Dräger technical service department for further information.

WARNING: When moving the anesthesia machine, remove all monitors and equipment from the top shelf, remove the absorber system, and use only the machine handles or push/pull bars. The anesthesia machine should only be moved by people who are physically capable of handling its weight. North American Dräger recommends that two people move the anesthesia machine to aid in maneuverability. Exercise special care so that the machine does not tip when moving up or down inclines, around corners, and across thresholds (for example, in door frames and elevators). Do not attempt to pull the machine over any hoses, cords, or other obstacles on the floor.

CAUTION: Although the Narkomed 2B is designed to minimize the effects of ambient radio-frequency interference, machine functions may be adversely affected by the operation of electrosurgical equipment or short wave or microwave diathermy equipment in the vicinity.

CAUTION: Communications with external equipment may be temporarily affected by electromagnetic interference due to the use of electrosurgical equipment.

CAUTION: Do not place sensitive electronic equipment on or adjacent to the display screen.

CAUTION: Do not place more than 100 pounds on top of the Narkomed 2B monitor housing.

Recommendations

In the interest of patient safety, North American Dräger strongly advocates the use of an oxygen analyzer, pressure monitor, and either a volume monitor or an end-tidal CO_2 monitor in the breathing circuit at all times.

Because of the sophisticated nature of North American Dräger anesthesia equipment and its critical importance in the operating room setting, it is highly recommended that only appropriately trained and experienced professionals be permitted to service and maintain this equipment. Please contact North American Dräger's Technical Service Department at (800) 543-5047 for service of this equipment.

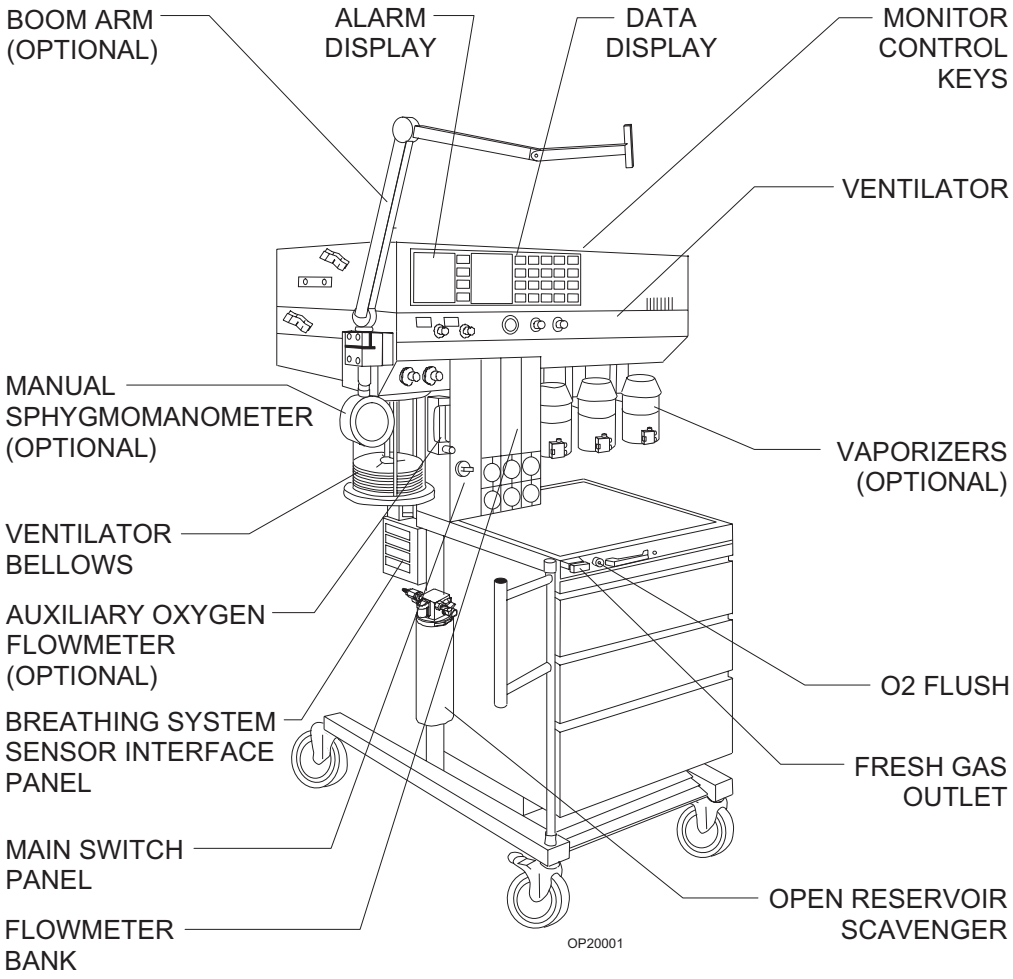
North American Dräger also recommends that its anesthesia equipment be serviced at three-month intervals. Periodic Manufacturer's Service Agreements are available for equipment manufactured by North American Dräger. For further information concerning these agreements, contact the North American Dräger Technical Service Department at (800) 543-5047.

RETURN TO CD-ROM TABLE OF CONTENTS

Section 2
General Description

Overview

The Narkomed® 2B is a continuous flow anesthesia system. All Narkomed 2B machines are equipped with a monitoring system and pneumatic circuitry for delivering gases and anesthetic vapor. A front view of the Narkomed 2B is shown in the figure below.



Gas Delivery System

The pneumatic system can simultaneously deliver up to four gases and one anesthetic agent (from a selection of up to three). Oxygen and nitrous oxide are standard on all Narkomed 2B machines. Optional gases are air, carbon dioxide, and oxygen-helium. Gas is supplied to the system through pipelines and cylinders. Connections for oxygen and nitrous oxide are standard on all machines, and a pipeline connection for air is also available. Gas cylinder yokes are available for up to two oxygen cylinders and two nitrous oxide cylinders, plus one additional cylinder for a third gas.

Section 2
General Description

Color Coding

Each connection, valve, gauge, and flowmeter is labeled and color-coded for the appropriate gas, as shown in the table below.

GAS SYSTEM COLOR CODING

GAS	MARKING	USA	ISO	Germany
Air	AIR	Yellow	Black/White Checkered	Yellow
Carbon Dioxide	CO_2	Gray	Gray	Black
Nitrous Oxide	N_2O	Blue	Blue	Gray
Oxygen	O_2	Green	White	Blue
Oxygen-Helium	O_2-He	Brown/Green Diagonal Stripes	Brown/White Diagonal Stripes	N/A

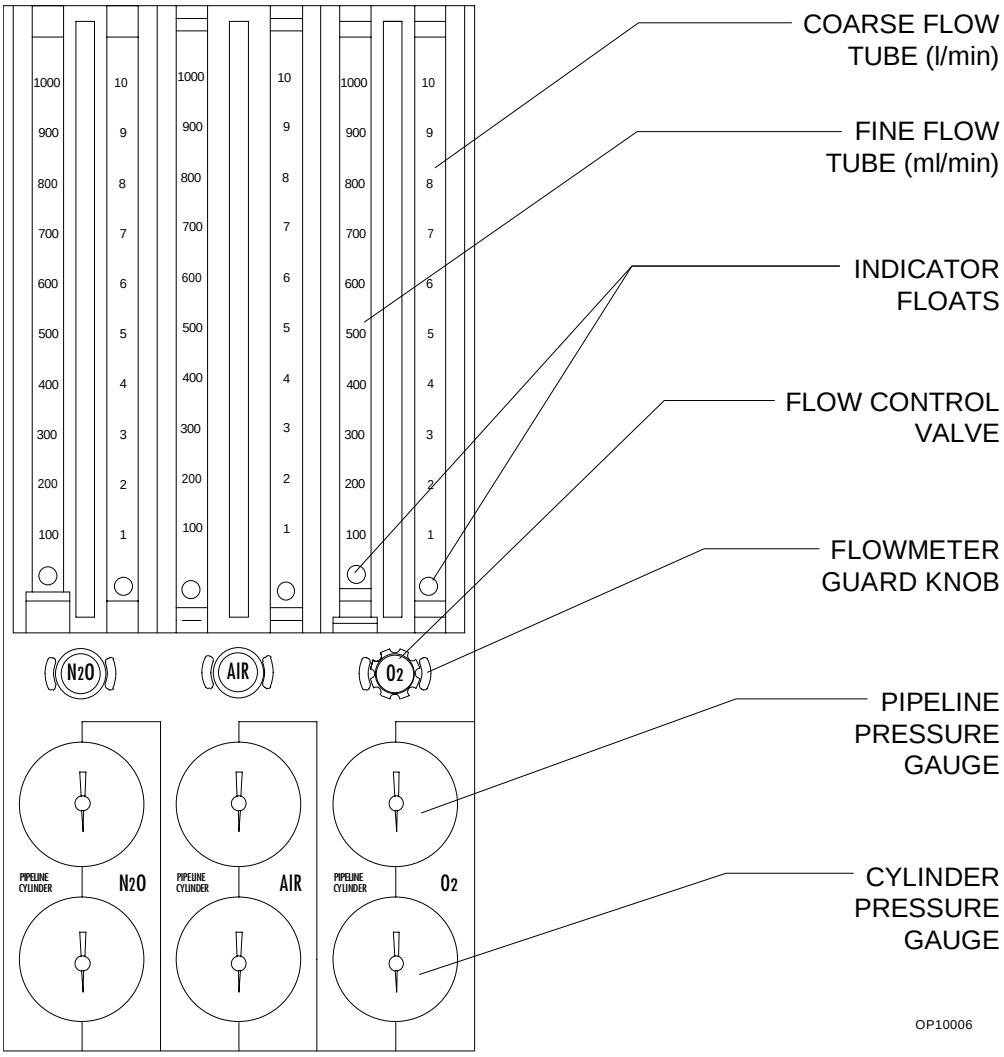
Gas Entry Via Pipeline

Gas from the hospital pipelines enters the Narkomed 2B through hoses connected to indexed pipeline inlets located on the side of the flowmeter housing. The indexed connector system reduces the risk of delivering the wrong gas to a patient by preventing incorrect connection of gas pipes. The inlets include check valves, which prevent back flow leakage into the atmosphere (when supply hoses are not connected) or into the attached supply hoses (when reserve cylinders are in use). Each pipeline connection is equipped with a filter to prevent foreign material from entering the internal gas piping of the Narkomed 2B. Pipeline gases should be supplied at 50–55 psi.

Pipeline Pressure Gauges

The anesthesia machine includes pipeline pressure gauges for oxygen and nitrous oxide. On machines equipped with air, a pipeline pressure gauge for air is also included. The gauges are located directly below their corresponding flowmeters and flow control valves, and are labeled and color-coded for their respective gases. Concentric scales in psi and kPa indicate the pipeline supply pressure. A typical pressure gauge and flowmeter arrangement is shown in the following figure.

THREE-GAS FLOWMETER
AND PRESSURE GAUGE ASSEMBLY



When the machine is connected to an active pipeline supply, each gauge should indicate a steady pressure of 50–55 psi. A deviation from this range indicates an improperly adjusted pipeline supply, which may adversely affect the operation of the anesthesia machine. A fluctuating pipeline supply pressure, for example, would cause a corresponding fluctuation of the flow of gas delivered from that pipeline. An excessively low pipeline pressure may activate the corresponding reserve cylinder and deplete its contents (if the reserve cylinder valve was left in the open position).

CAUTION: To ensure that gas supplies are at adequate pressure, pipeline pressure gauges should indicate steady pressures of 50–55 psi.

Section 2
General Description

Gas Entry Via Cylinder Yokes

The Narkomed 2B can be equipped with a maximum of two oxygen and two nitrous oxide cylinder hanger yokes. An additional yoke for an optional third gas is also available. To prevent a cylinder from being improperly connected, the yokes are labeled, color-coded, and keyed for gas-specific cylinders using the pin-indexed safety system.

A filter within each yoke prevents foreign material from entering the internal gas piping of the Narkomed 2B. A check valve in each yoke prevents leakage into the atmosphere if the cylinder is not mounted on the yoke. When the machine is configured with two yokes for the same gas, the check valve prevents movement of gas from one cylinder to the other. If a cylinder is not mounted to a yoke, the attached yoke plug should be placed between the yoke handle's threaded bolt and the yoke's gas inlet.

When attaching a cylinder, make sure that only one washer is installed between the cylinder and the yoke gas inlet. Using multiple washers may compromise the pin-indexed safety system. Be sure to verify the integrity of both index pins whenever you install a new cylinder.

WARNING: Check cylinder yokes for the presence of two index pins each time you attach a cylinder to the machine. Use only one cylinder gasket per yoke; using more than one gasket could cause leakage of the cylinder gas and compromise the pin-indexed safety system.

Cylinders attached to the hanger yokes must contain gas at the recommended pressures outlined in the table below. (Indicated pressures are of E-size cylinders at 70°F, or 21°C.) Cylinders measuring less than the minimum recommended pressure (PSI - MIN) should be replaced with new, full cylinders.

GAS	PSI - FULL*	PSI - MIN
Air	1900	1000
Carbon Dioxide	838	600
Oxygen-Helium	1900	1000
Nitrous Oxide	745	600
Oxygen	1900	1000

* typical full load

Cylinder Pressure Gauges

Each cylinder gas circuit has a cylinder pressure gauge, located at the bottom of the flowmeter panel on the front of the machine (see the Flowmeter and Pressure Gauge Assembly figure earlier in this section.) Each gauge is labeled and color-coded for its respective gas. When a cylinder's valve is open, its pressure gauge indicates the gas pressure in the cylinder. The dial is marked with concentric scales for psi and kPa. If two reserve cylinders of the same gas are open at the same time, the gauge indicates the pressure in the cylinder having the higher pressure.

For nonliquefied gases (oxygen, air, oxygen-helium), the indicated pressure is proportional to the gas content of the cylinder. For liquefied gases (nitrous oxide, carbon dioxide), the gauge indicates the vapor pressure of the liquefied gas in the cylinder. This pressure remains constant until all of the liquid in the cylinder has vaporized. When the liquid has vaporized, the cylinder pressure decreases proportionally as gas is removed from the cylinder.

Oxygen Failure Protection Device (OFPD)

An oxygen failure protection device (OFPD) is a pneumatically operated valve that protects the patient in the event of partial or complete loss of oxygen pressure. Each gas circuit in the anesthesia machine, except the oxygen circuit, is controlled by one of these valves. These valves, in turn, are controlled by the gas pressure in the oxygen supply line. When oxygen pressure is adequate, the valves remain open for an unrestricted gas flow. Loss of oxgyen pressure causes the valves to close to a degree that is proportional to the loss. The result is a restriction or shut down of the flow of all gases except oxygen.

Reductions of gas flow are indicated on the flowmeters. In addition, if the oxygen supply pressure drops below approximately 37 psi, an oxygen supply pressure alarm is activated, causing the following events to occur:

- The Caution message LO O_2 SUPPLY appears on the central alarm display.
- The red O_2 SUPPLY PRESSURE indicator on the main switch panel lights.
- An intermittent audible alarm sounds.
- A 7-second whistle may sound, depending on the machine's configuration.

NOTE: When one source of oxygen pressure (either pipeline or reserve cylinders) fails, but the other source is able to maintain proper pressure within the machine's oxygen supply lines, the oxygen supply pressure alarm is not activated.

Section 2
General Description

Flowmeters

Flowmeters, located directly above their corresponding flow control valves, display the delivered flow rate of each gas in the fresh gas mixture. Dual flowmeter tubes (fine and coarse) are used in tandem for oxygen, nitrous oxide, and air (if provided). When other gases are supplied, single flowmeter tubes are used. All flowmeters are labeled at each end of the flowtube. A typical flowmeter arrangement is shown in the Flowmeter and Pressure Gauge Assembly figure earlier in this section.

Each flowmeter has a float indicator. To determine the flow rate, read the flowmeter scale at the center of the float.

Low-Flow Flowmeters (Optional)

For low-flow anesthesia, the Narkomed 2B can be configured with low-flow, dual-tube flowmeters for oxygen and nitrous oxide. These flowmeters function the same way as the standard dual-tube flowmeters, but they are calibrated to provide greater resolution for low-flow anesthesia.

Minimum Oxygen Flow

The oxygen dispensing system incorporates a calibrated bypass flow of 150 ±50 ml/min (at 50 psi pipeline pressure), which delivers this volume of oxygen even if the oxygen flow control valve is fully closed.

Flow Control Valves

A needle valve is located below the fine flowmeter tube for each gas. This valve is used to adjust the flow of gas. Turning the valve knob counterclockwise increases flow; turning the knob clockwise decreases flow. A zero stop prevents damage to the flow control valve seats. If necessary, a North American Dräger qualified technical service representative can readjust the stop.

Each flow control knob is identified by its color code and chemical symbol. The oxygen flow control valve is also touch-coded with a deeply fluted knob.

CAUTION: The flow of oxygen cannot be completely shut off (see “Minimum Oxygen Flow” earlier in this section). Do not force the oxygen flow control knob in an effort to shut off the minimum flow; forcing the knob can damage the valve seat.

Oxygen Flush

A manually operated, self-closing oxygen flush valve is located on the front of the machine. A bezel is mounted around the pushbutton in order to prevent accidental engagement. The valve, when actuated, delivers an unmetered oxygen flow of approximately 55 l/min directly to the Narkomed 2B's fresh gas common outlet. The SYSTEM POWER switch does not have to be in the ON position to use the oxygen flush.

Oxygen Ratio Controller (ORC)

The ORC is a pneumatic oxygen/nitrous oxide interlock system. It maintains a fresh gas oxygen concentration of 25 ±4% and permits independent control of the oxygen and nitrous oxide flows.

The ORC proportionally limits the nitrous oxide flow whenever the selected oxygen and nitrous oxide flow control valve settings would otherwise result in a hypoxic fresh gas mixture. For example, if you open the nitrous oxide flow control valve excessively without making a corresponding increase in the oxygen flow control valve setting, the flow of nitrous oxide will not increase even though its flow control valve setting has been greatly increased. Similarly, if you decrease the oxygen flow without also decreasing the nitrous oxide flow, the nitrous oxide flow will automatically drop in proportion to the oxygen flow.

WARNING: In circle systems the gas mixture in the patient circuit is not necessarily the same as that in the fresh gas flow. This is particularly true at low fresh gas flow rates when the patient rebreathes a significant portion of previously exhaled gases. It is important that the gas mixture in the patient circuit be monitored, and that the fresh gas flow be adjusted to meet the requirements of the patient as well as to compensate for any patient uptake, system leakage, or gas withdrawn through sample lines and not returned.

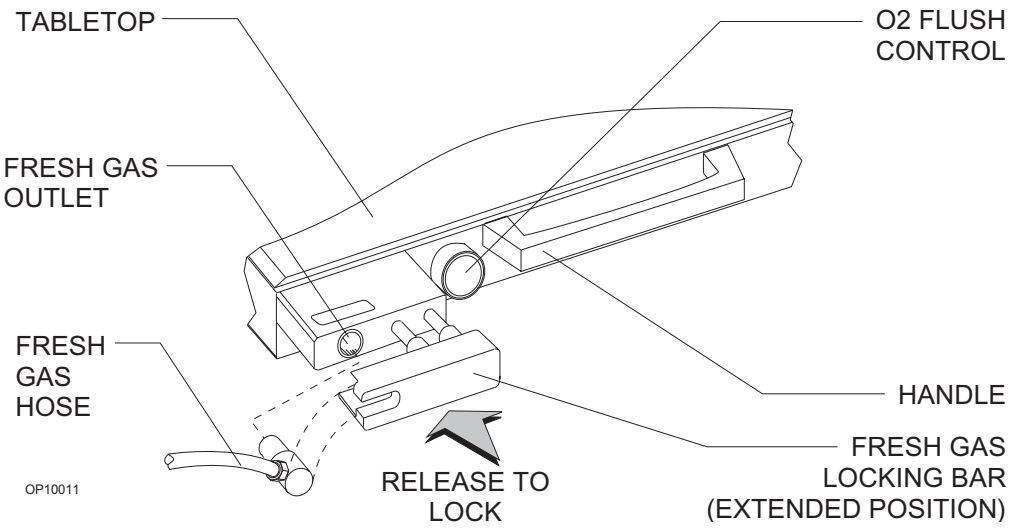
WARNING: The ORC interlocks only the flows of oxygen and nitrous oxide. Hypoxic fresh gas concentrations are possible if carbon dioxide is used as an additional gas.

Section 2
General Description

Fresh Gas Outlet

The fresh gas outlet delivers the fresh gas mixture (consisting of oxygen, nitrous oxide, optional gases, and vapors of a liquid anesthetic) to the patient breathing system. It is located on the front of the anesthesia machine.

The outlet's 15 mm cylindrical female fitting is designed to accept a 15 mm male fitting on the absorber fresh gas hose. The male fitting slides into a retaining slot in the spring-loaded safety locking bar to prevent inadvertent disconnection of the fresh gas hose. The 15 mm male fitting on the fresh gas hose is unique to North American Dräger design, and cannot be replaced by a hose from any other manufacturer.

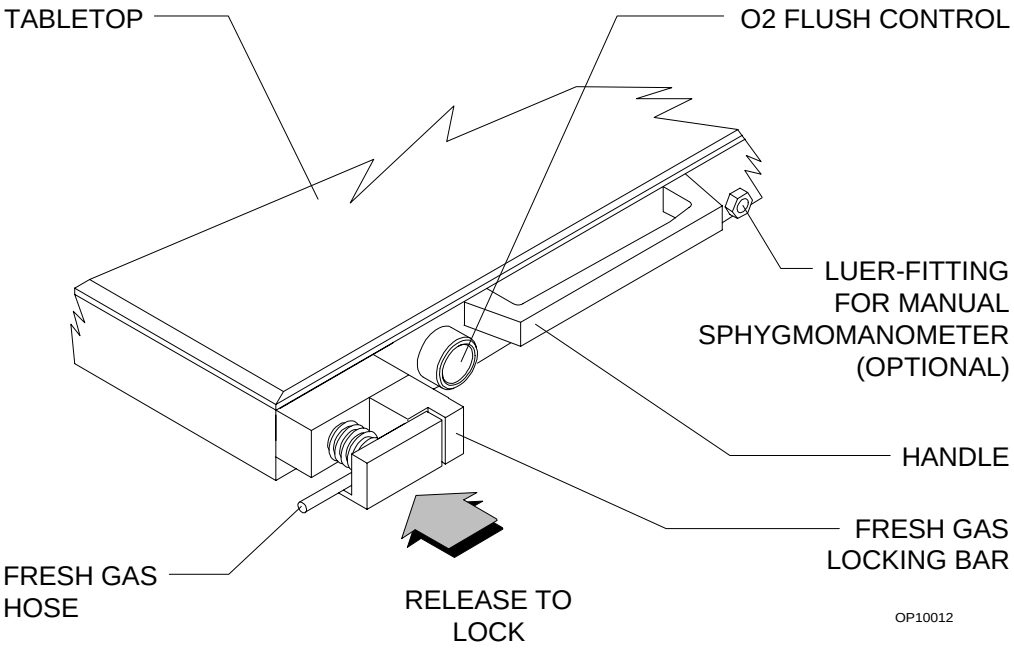


Fresh Gas Outlet (Canada)

The fresh gas outlet, located on the front of the machine, delivers the fresh gas mixture to the patient breathing system. The fresh gas mixture consists of oxygen, nitrous oxide, optional gases, and vapors of a liquid anesthetic.

The fresh gas outlet has a dual fitting that lets you use a gas hose with either of the following types of fittings:

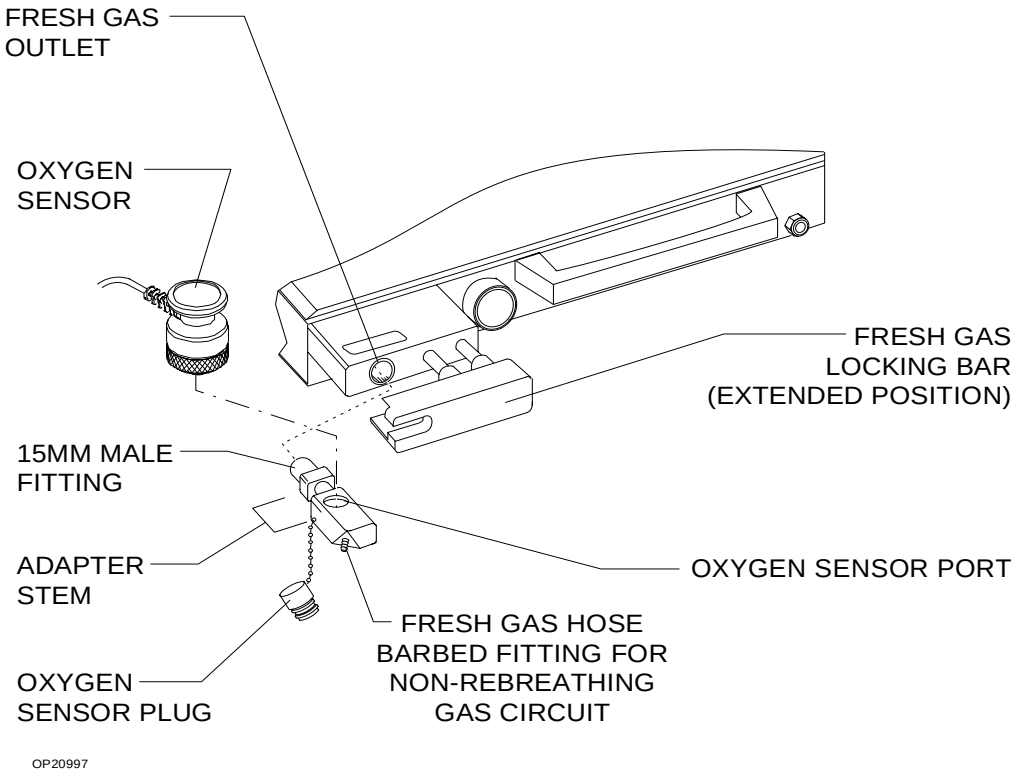
- A 15 mm male fitting, such as those supplied with North American Dräger Absorbers and Bain Circuit Adapters. When using a 15 mm fitting, place the spring-loaded locking bar over the male fitting to secure it to the female fitting.
- A 22 mm female fitting with a load-bearing threaded mount, such as those for Magill circuits or ISO-type non-rebreathing adapters. When using an ISO-type non-rebreathing adapter, swing the spring-loaded locking bar to the side to gain access to the threaded load-bearing fitting.



Section 2
General Description

Fresh Gas Oxygen Sensor Adapter

The optional fresh gas adapter allows the Narkomed 2B to monitor the fresh gas oxygen concentration when using a nonrebreathing circuit (other than a Bain Circuit). The fresh gas adapter fits securely into the fresh gas outlet of the anesthesia machine. It incorporates a port for an oxygen analyzer sensor and a fitting for a non-rebreathing circuit.



WARNING: The fresh gas oxygen sensor adapter measures the fresh gas oxygen concentration, not the inspiratory oxygen concentration. Depending on the fresh gas flow and the respiratory minute volume, the inspiratory oxygen concentration may be lower than fresh gas oxygen concentration due to rebreathing of previously exhaled gases.

Auxiliary Oxygen Flowmeter (Optional)

For the delivery of a metered flow of pure oxygen (for example, delivery of oxygen through a nasal cannula), an optional auxiliary oxygen flowmeter can be mounted on the left side of the flowmeter bank. This flowmeter can be used when the machine is turned off. A zero stop prevents damage to the flow control valve seat.

Vaporizers

The Narkomed 2B can be equipped with up to three Vapor 19.1 vaporizers for administering liquid anesthetics.

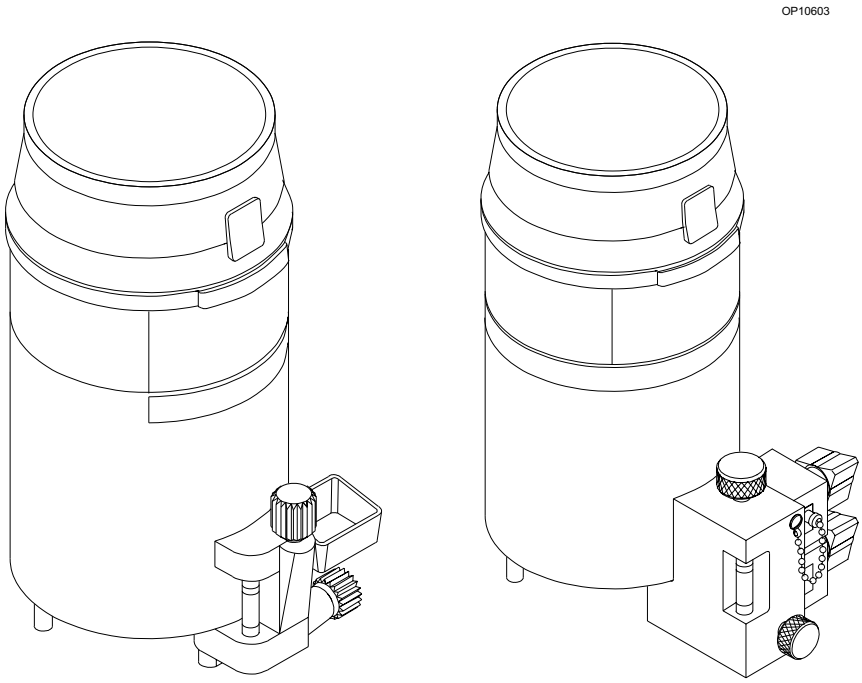
Exclusion System

A cam and lever interlock system, incorporated into the vaporizer bank, prevents more than one vaporizer from being activated at a time. The interlock system requires all unused vaporizers to be locked in their zero volume percent positions.

WARNING: Only one vaporizer can be activated at a time. If the exclusion system permits simultaneous activation of more than one vaporizer, do not use the anesthesia machine. Contact a North American Dräger qualified technical service representative for adjustment.

Filling Systems

Two filling systems are available for the Vapor 19.1 vaporizer: the open funnel system and the key-indexed safety system.



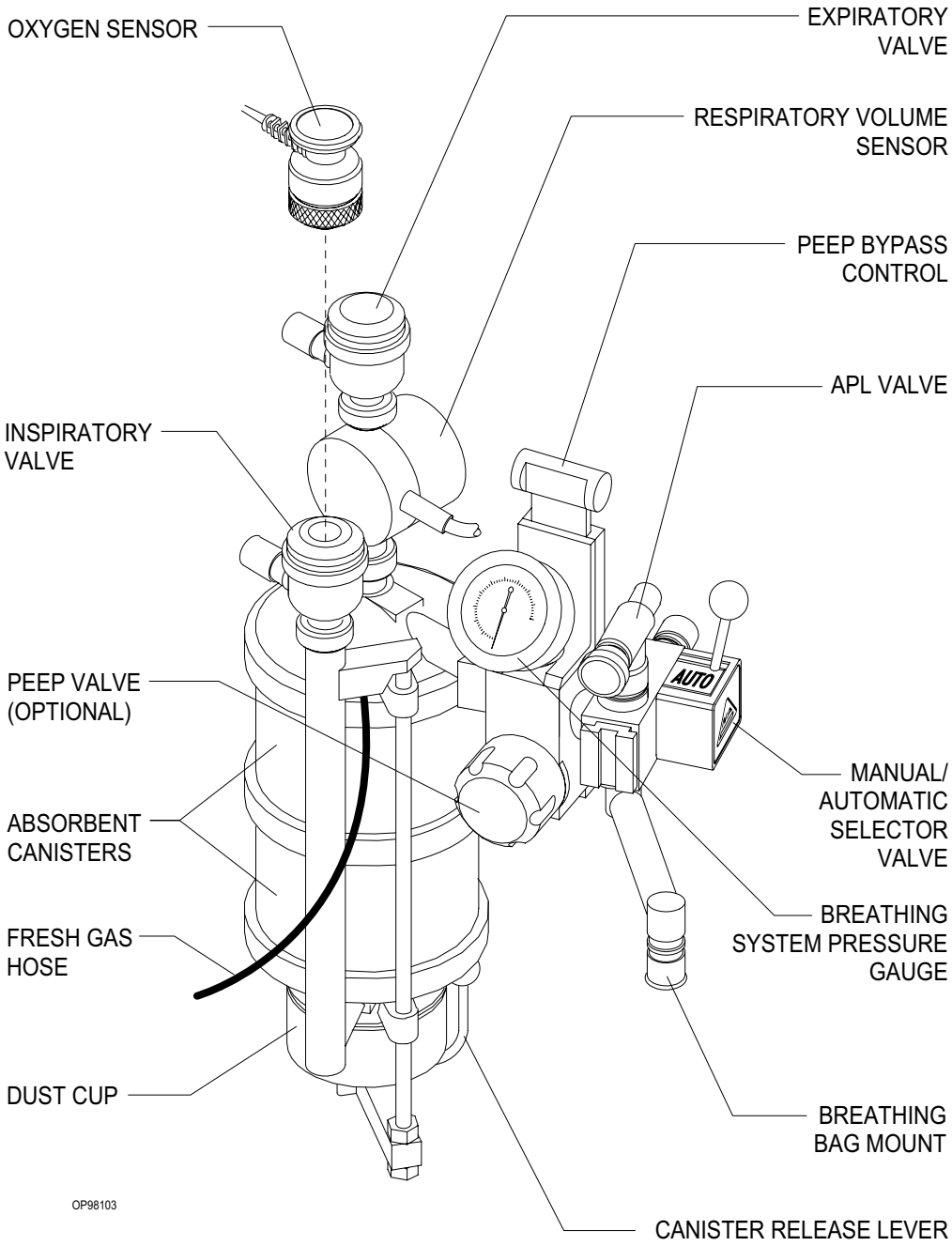
OPEN FUNNEL FILLER

KEY INDEXED
SAFETY SYSTEM

Section 2
General Description

Absorber

The absorber is a dual-canister system for absorbing exhaled carbon dioxide in the rebreathing circuit of the anesthesia machine. It incorporates an adjustable pressure limiter (APL) valve, a breathing system pressure gauge, a fresh gas line, and connections for sensing the following: breathing pressure, respiratory volume, frequency, and oxygen concentration.



The absorber system permits spontaneous, manually assisted, or automatic ventilation of the patient. The absorber incorporates a manual/automatic selector valve, which allows you to select either manual or automatic ventilation. An absorber with a positive end expiratory pressure (PEEP) valve is also available.

WARNING: Waste gas scavenging systems used with North American Dräger absorber systems must have safety features to ensure that excessive subatmospheric pressure (lower than -0.5 cmH_2O) and excessive positive pressure (higher than +0.5 cmH_2O) are not possible at the connection point.

Inspiratory and Expiratory Valves

The inspiratory and expiratory valves, labeled INSPIRATION and EXPIRATION, respectively, control the direction of gas flow in the absorber system. The valves are unidirectional, meaning that they permit gas to flow in one direction only.

- The inspiratory valve allows gas to flow toward the patient only, with no backflow to the absorber.
- The expiratory valve allows gas to flow to the absorber only, with no backflow to the patient.

The valves are *not* interchangeable. They must be connected to the correct mounts (inspiratory valve to inspiratory mount, expiratory valve to expiratory mount) to ensure the proper flow direction through the absorber system. Different size mounting threads on each valve prevent connection of a valve to the wrong mount.

WARNING: Do not use the inspiratory or expiratory valve if any one of these problems occurs:
- A pin in the valve body or plastic valve dome is bent, damaged, or missing.
- The valve disk is missing or damaged.
- The valve seat is damaged.

Section 2
General Description

Canisters

Each absorber unit contains two interchangeable transparent plastic canisters which house the absorbent. The absorbent, soda lime or barium hydroxide lime, can be purchased in either loose granular or prepacked cartridge form.

Dust Cup

A removable, transparent plastic cup below the bottom assembly collects absorbent dust and excess moisture which could cause increased flow resistance in the system.

Breathing System Pressure Gauge

The absorber system is equipped with a pressure gauge to enable quick visual determination of breathing circuit pressure. The gauge is marked for measurements from -20 to +80 cmH_2O in increments of 2 cmH_2O.

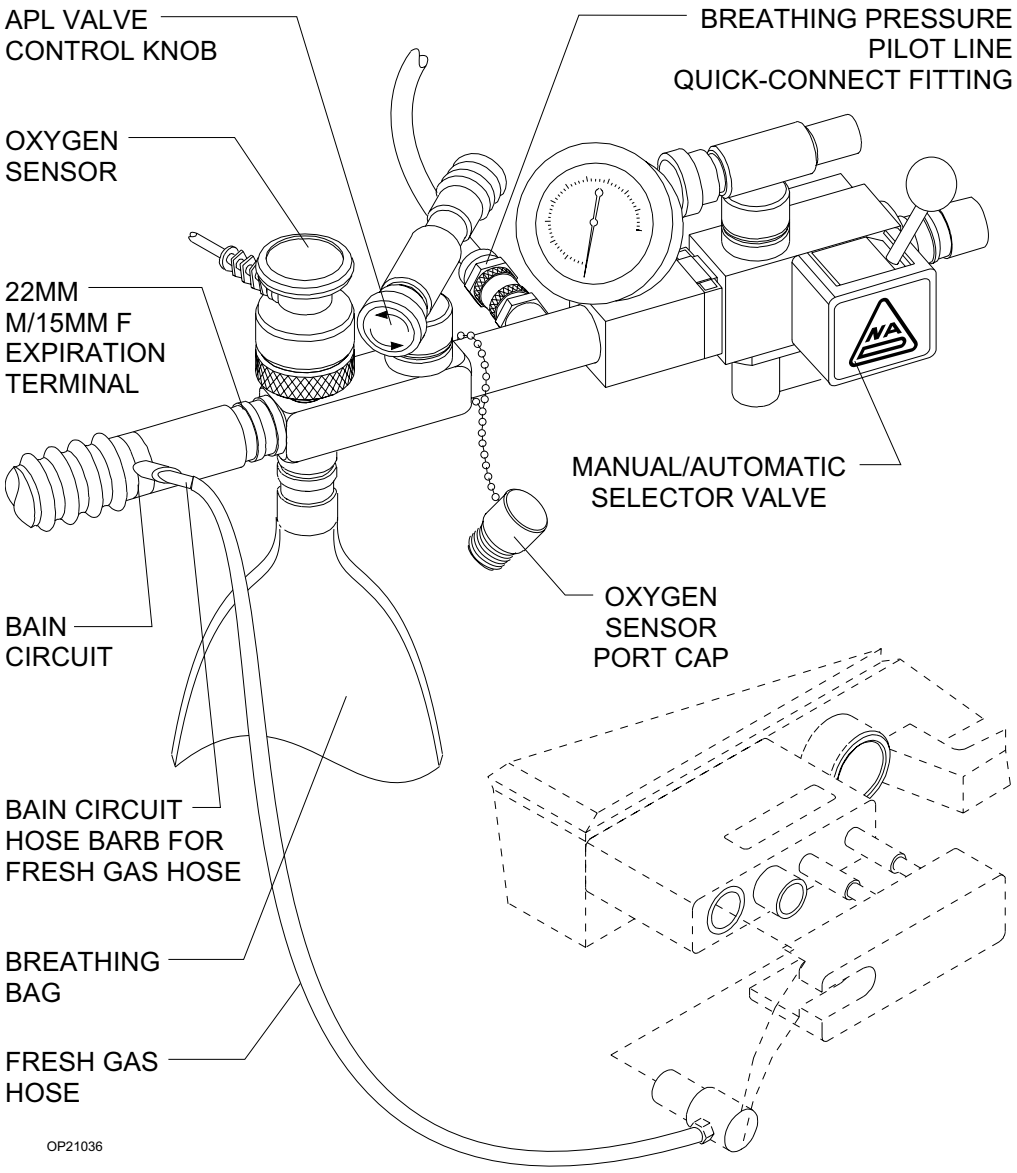
WARNING: Frequent observation of the breathing system pressure gauge is mandatory to ensure adequate pressure buildup and relief, regardless of the mode of operation.

Bain Circuit Adapters

Two types of Bain circuit adapters are available. One mounts to the absorber; the other mounts to the absorber pole.

Absorber Mount

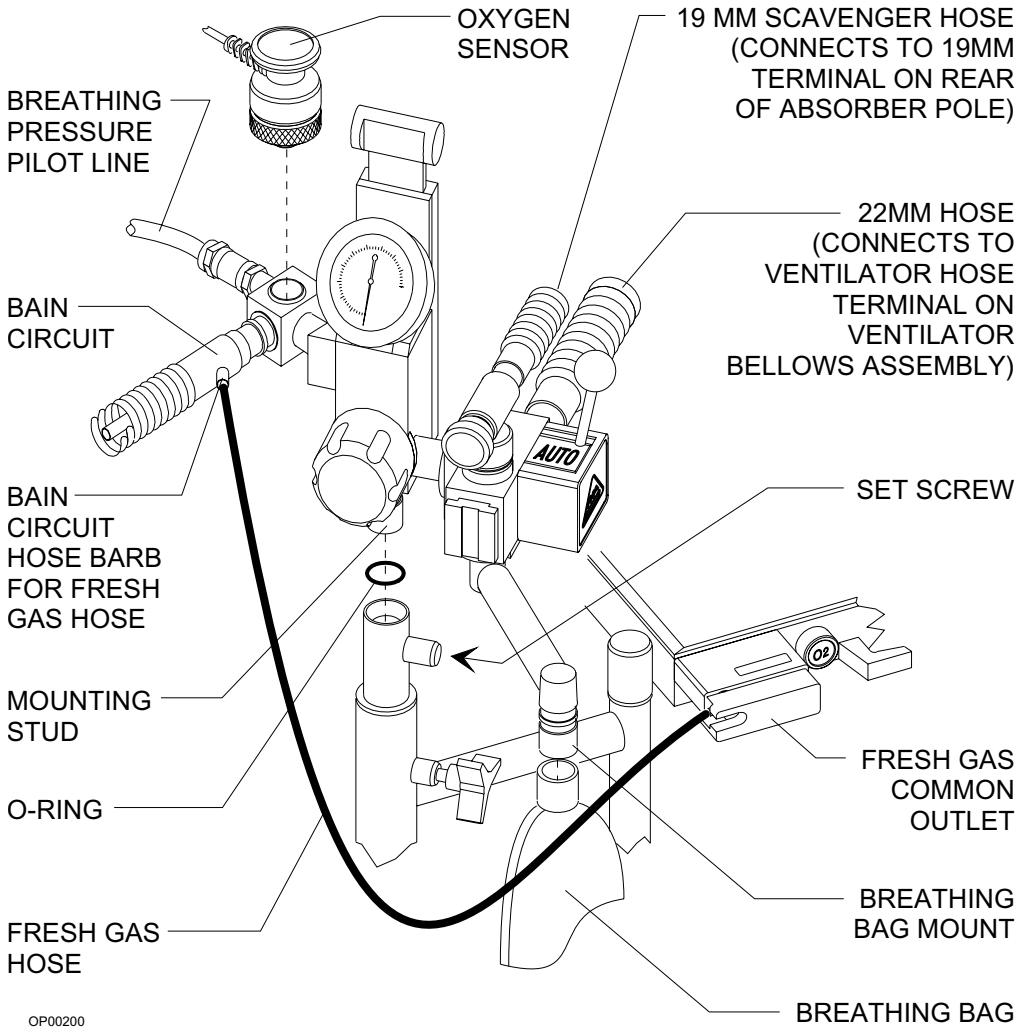
The absorber-mounted Bain circuit adapter, shown in the following illustration, mounts onto the manual/automatic selector valve of the absorber system. The adapter includes an adjustable pressure limiter (APL) valve, a breathing pressure gauge, a quick-connect fitting for the breathing pressure pilot line, a port for the oxygen sensor, a 15/22 mm port for non-rebreathing circuits, and a connector for a patient breathing bag.



Section 2
General Description

Pole Mount

The pole-mounted Bain Circuit adapter, shown in the following illustration, mounts on the absorber pole. It may be supplied with or without a positive end-expiratory pressure (PEEP) valve.

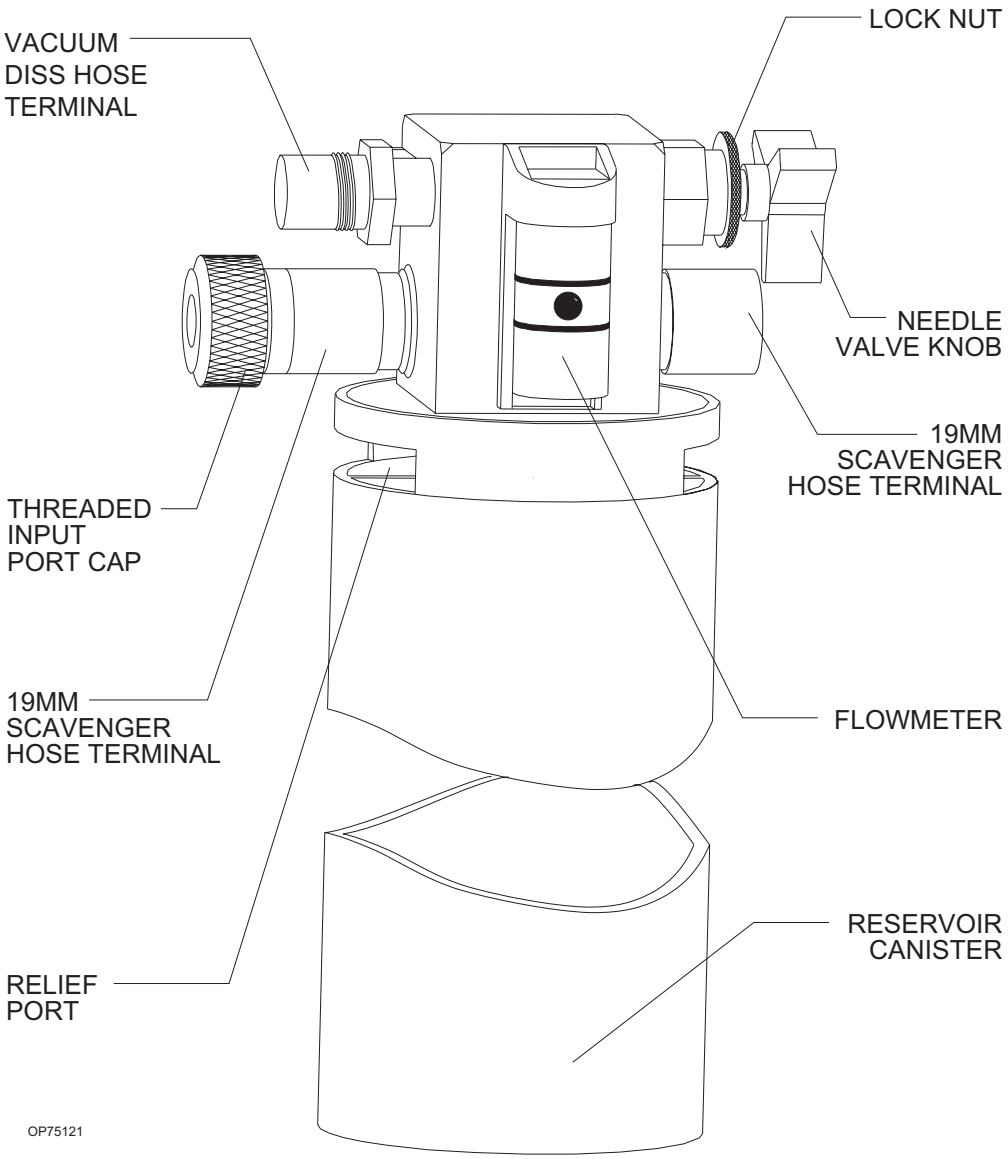


Scavenger Systems

The Narkomed 2B can be equipped with two kinds of scavenger systems, permitting the best match with the hospital's waste gas disposal system.

Open Reservoir Scavenger

The open reservoir scavenger is used with suction (vacuum) waste gas disposal systems. This scavenger is an "open" system, featuring continually open relief ports to provide positive and negative pressure relief.

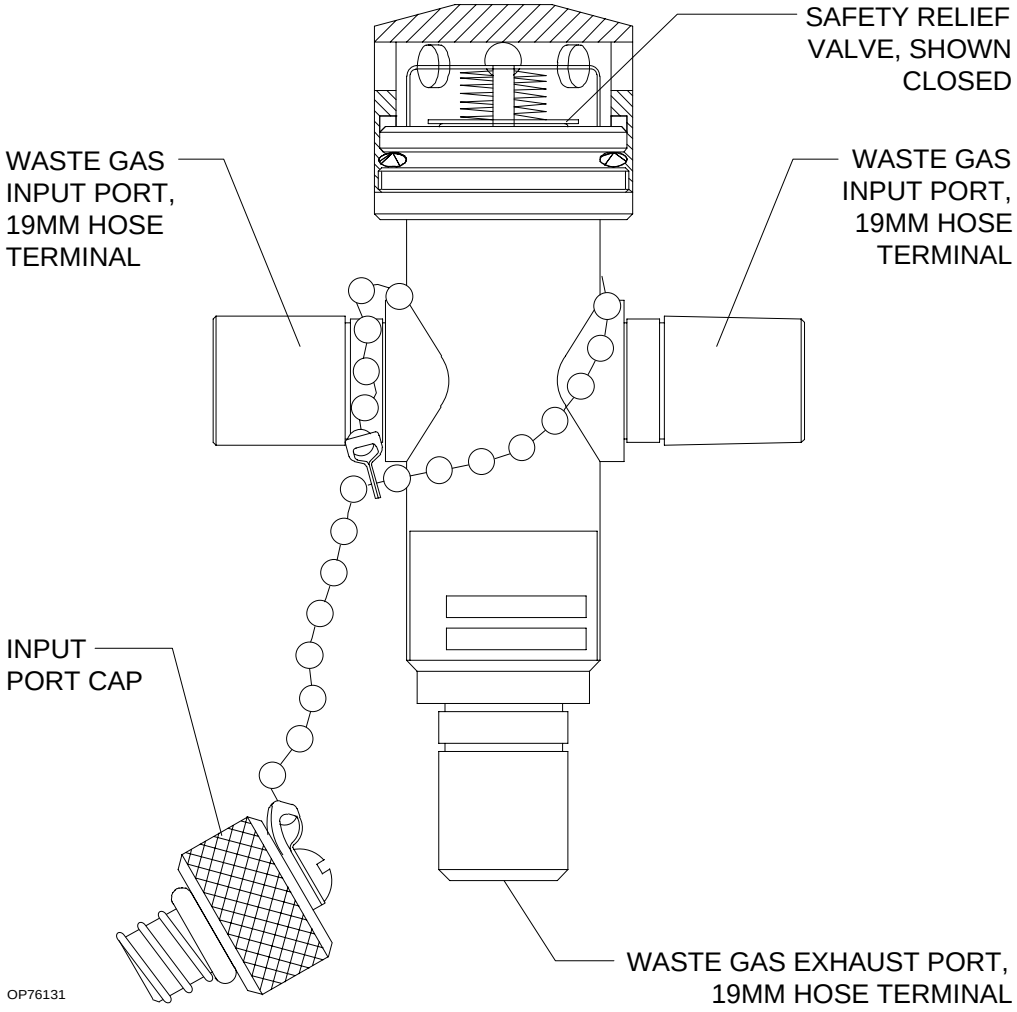


Section 2
General Description

Scavenger Interface for Passive Systems

The scavenger interface for passive systems is used with nonrecirculating HVAC systems (also called exhaust systems). This scavenger is a “closed” system, using a spring-loaded valve for positive pressure relief.

WARNING: Do not use this device with a waste gas disposal system capable of applying a negative pressure to the scavenger interface (a suction or vacuum waste gas disposal system).


SAFETY RELIEF VALVE, SHOWN CLOSED
WASTE GAS INPUT PORT, 19MM HOSE TERMINAL
WASTE GAS INPUT PORT, 19MM HOSE TERMINAL
INPUT PORT CAP
WASTE GAS EXHAUST PORT, 19MM HOSE TERMINAL
OP76131

AV2+ Ventilator

The AV2+ anesthesia ventilator is a volume preset, time cycled, pressure limited ventilator with electronic timing, pneumatic circuitry and independent controls for frequency, inspiratory to expiratory (I:E) ratio, inspiratory flow rate, tidal volume, and inspiratory pressure limiting.

Pneumatic power (bellows drive gas) to the ventilator is supplied through the hospital pipeline supply or through reserve cylinders on the anesthesia machine. The pressure of the supply gas must be between 40 and 60 psi. The ventilator will not function properly if this pressure drops below 32 psi. Electrical power is supplied by the Narkomed 2B's AC power source, or, in event of AC power failure, by the backup battery. A fully charged battery can power the ventilator for approximately 30 minutes.

The anesthesia ventilator is designed for use with a North American Dräger absorber system, which incorporates a manual/automatic selector valve. This valve allows you to select either the breathing bag and adjustable pressure limiter (APL) valve for manual ventilation, or the ventilator bellows for automatic ventilation.

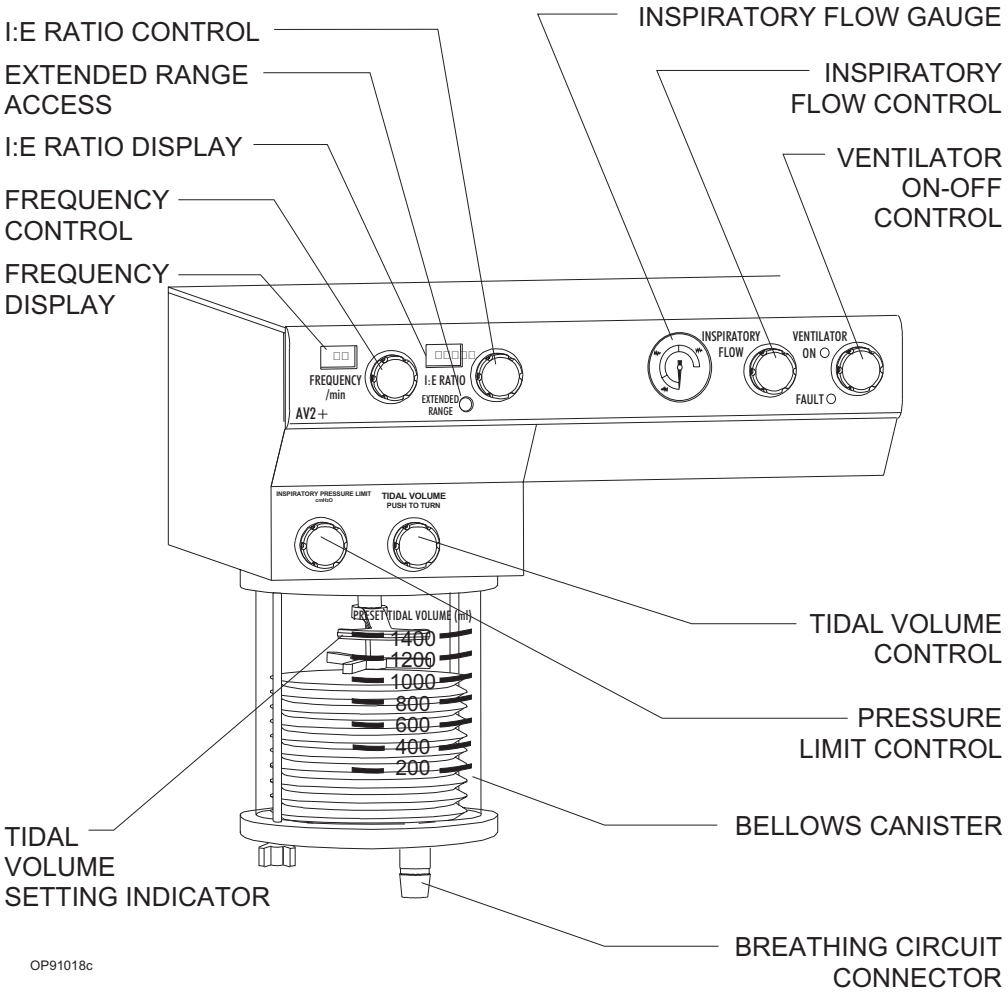
During automatic ventilation, the manual/automatic selector valve isolates the absorber's APL valve from the breathing system. To compensate for the continuous introduction of fresh gas into the breathing system, the ventilator incorporates a relief valve mounted behind the bellows chamber.

When the bellows is completely filled, any excess gas in the system is released to the scavenging system through the ventilator relief valve. As in any ascending bellows, the force needed to overcome gravity acting on the bellows causes a positive end-expiratory pressure (PEEP) within the breathing system. For the Narkomed 2B, the PEEP is approximately 2 cmH_2O.

The pressure limit control allows you to set the peak inspiratory pressure produced by the ventilator in order to help prevent barotrauma. The pressure limit control can also improve ventilation for patients with reduced lung compliance (neonatal/pediatric patients and patients with adult respiratory distress syndrome), because it limits the peak inspiratory pressure during the inspiratory phase of ventilation.

The AV2+ ventilator is shown in the following drawing.

Section 2
General Description



Main Switch Panel

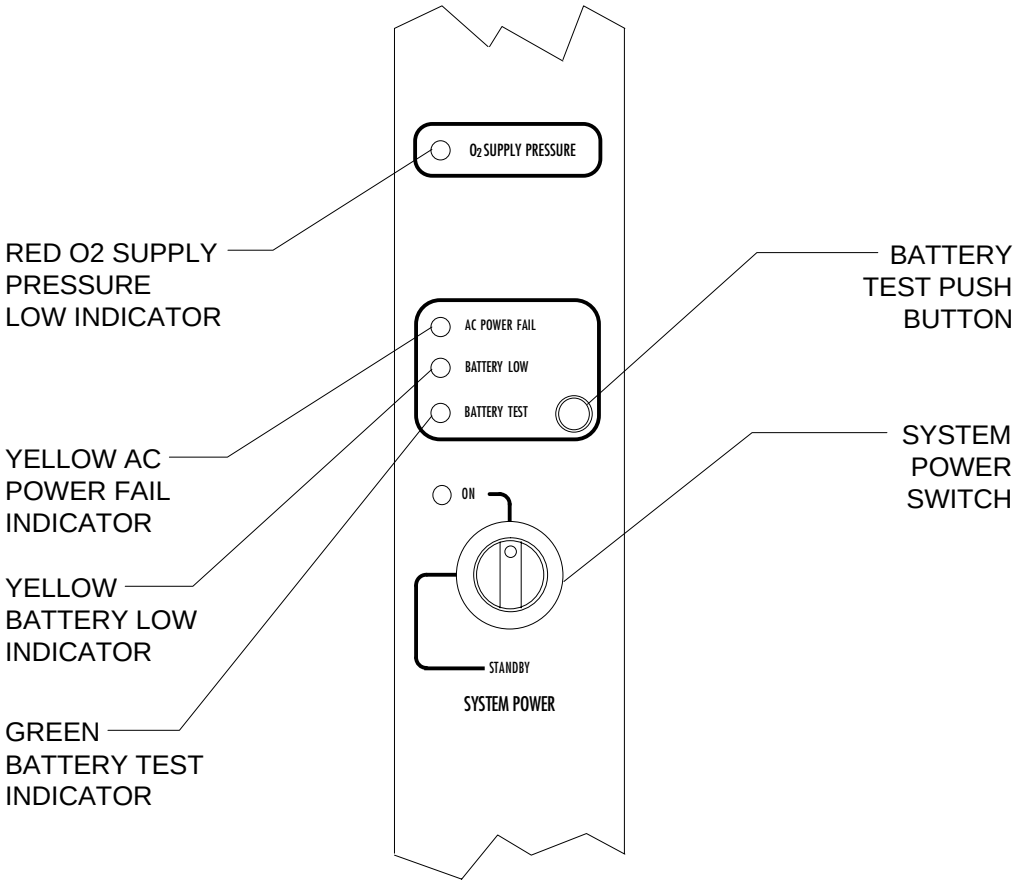
The main switch panel is located between the ventilator bellows and flowmeter bank.

System Power Switch

The SYSTEM POWER switch on the Narkomed 2B has two positions: ON and STANDBY. In the ON position, the gas (pneumatic) and electric power circuits are actuated, and the green LED indicator adjacent to the switch illuminates. In the STANDBY position, the switch shuts down the gas supplies, the monitoring system, and all electrical power to the machine except the convenience receptacles and battery charging circuit.

AC Power Failure Indicator

The yellow AC POWER FAIL LED signals a disruption of AC power. The LED is illuminated whenever the battery supplies power to the monitoring system and the electronic ventilator. A single tone also sounds when AC power is first disrupted. If the anesthesia machine's backup battery is completely discharged, the AC power failure indicator does not have power and will not function.



OP20050

Oxygen Supply Pressure Alarm

The oxygen supply pressure alarm is activated when the oxygen supply pressure in the system falls below approximately 37 psi. When the alarm is activated, the red O_2 SUPPLY PRESSURE LED on the main switch panel lights. In addition, the Caution message LO O_2 SUPPLY appears on the central alarm display and an intermittent audible alarm sounds. Depending on the anesthesia machine's configuration, a 7-second whistle may also sound.

NOTE: When one source of oxygen pressure (either pipeline or reserve cylinders) fails, but the other source is able to maintain proper pressure within the machine's oxygen supply lines, the oxygen supply pressure alarm is not activated.

Section 2
General Description

Power Supply System

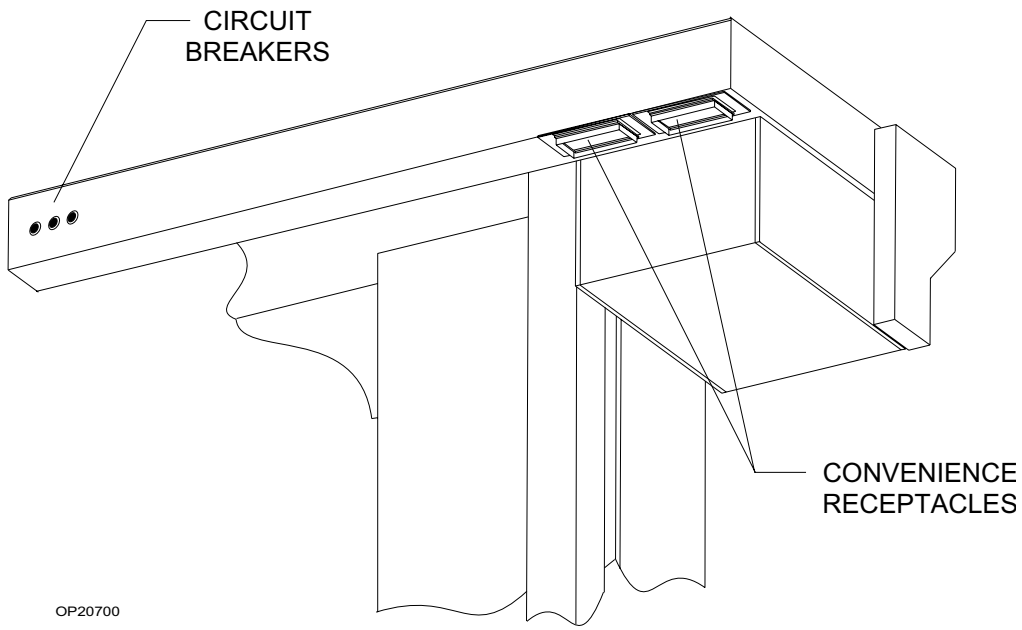
The Narkomed 2B is equipped with a central power supply for the ventilator, alarm system, and monitoring system. When in use, the Narkomed 2B must be plugged into an AC outlet.

Convenience Receptacles

The Narkomed 2B is equipped with four convenience receptacles, mounted on the under side of the rear of the monitor bank. (Machines with the 240 VAC power supply are not equippped with convenience receptacles). The receptacles are active whenever the Narkomed 2B is plugged into an outlet, whether or not the machine is turned on.

The total current for devices plugged into the receptacles must not exceed 5 amps. A 5 amp circuit breaker protects the convenience receptacle circuit. This circuit also incorporates an EMI filter, which minimizes interference to the anesthesia machine from devices plugged into the convenience receptacles.

CAUTION: Devices plugged into the convenience receptacles contribute to the anesthesia system's total leakage current. The total leakage current (for system and external devices combined) must not exceed 100 microamps.



Circuit Breakers

The electrical system includes three magnetic circuit breakers to protect machine functions (primary AC power input, convenience receptacles, and backup battery power). The circuit breakers are located on the rear of the monitoring bank.

When the plunger is flush with the surface of its base, the circuit breaker is in its normal, closed position. A circuit breaker is open (tripped) when its plunger extends beyond its base. If a breaker is tripped, the cause must be found and corrected before using the anesthesia system.

Backup Battery System

The backup battery system consists of a rechargeable battery and a built-in battery charging system.

Although most hospitals have emergency generators that provide AC power when line power fails, a delay may occur before generator power comes on line. The backup battery system automatically provides power during the period between line power failure and activation of the hospital's emergency generator. The backup battery also provides power if the anesthesia machine's power cord is accidentally unplugged during a case.

When the hospital's emergency generator comes on-line (or when a disconnected power cord is reconnected), the Narkomed 2B automatically switches back to AC power and recharges its battery. The battery charging system charges the battery any time the power cord is connected to an active AC power source. The charger can recharge a fully discharged battery in approximately 16 hours.

Machine Functions on Backup Battery Power

If the hospital's primary AC power fails, the backup battery system is activated. All monitoring functions will continue for approximately 30 minutes if the battery is fully charged.

The following events signal activation of the backup battery system:

- The yellow AC POWER FAIL indicator on the anesthesia machine's alarm panel comes on.
- The Advisory message AC PWR FAIL appears on the central alarm display.
- A single tone sounds when AC power is first disrupted.

Section 2
General Description

When the battery reserve approaches depletion following an AC power loss:

- The yellow BATTERY LOW main switch panel indicator illuminates.

  NOTE: The BATTERY LOW indicator will only illuminate during an AC power loss when battery reserves are low.

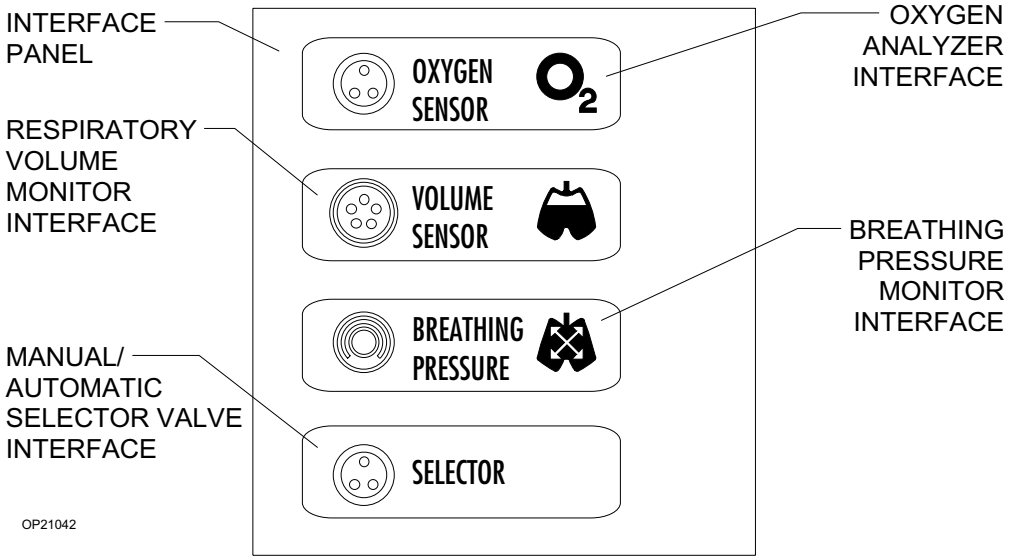
- The Caution message AC/BATT FAIL appears on the central alarm display.

The gas supply system remains operative. However, since the ventilator is inoperative when battery power is cut off, you must perform manual ventilation by bag. The machine cannot provide monitoring or alarm functions until AC power is restored.

NOTE: If the Narkomed 2B's power cord is not plugged into an active AC outlet for a period of 30 days or more, the backup battery may become depleted. Plugging the power cord into an active AC outlet for approximately 16 hours will recharge a depleted battery.

System Interface Panel

The system interface panel is located on the absorber side of the Narkomed 2B. The interface panel contains receptacles for the oxygen sensor cord, the breathing pressure pilot line, the respiratory volume sensor cord, and the manual/automatic selector valve interface cable.



Monitoring System

The anesthesia machine's monitoring system integrates the functions of the electronic monitors and organizes information from these monitors onto two screens. The screens are located on the front panel of the machine.

The Narkomed 2B monitors the following measurements:

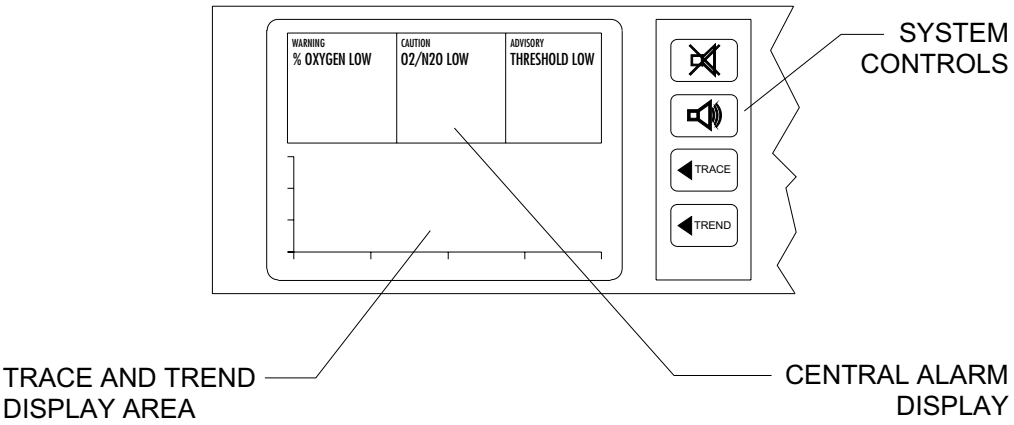
- oxygen concentration
- breathing pressure
- respiratory volume

The anesthesia machine also monitors key anesthesia system functions, such as oxygen supply pressure and backup battery status.

Left-Hand Screen and Controls

This screen shows alarms, trends, and the breathing pressure waveform, or trace. To the right of the screen are the system control keys, which let you control the audio annunciation of alarms and switch between trace and trend displays.

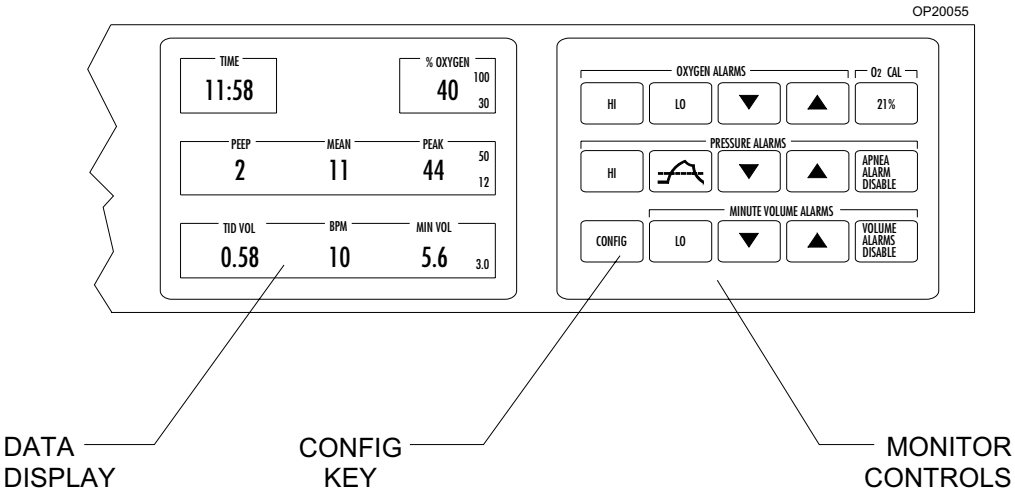
OP20015



Section 2
General Description

Right-Hand Screen and Controls

This screen displays numerical data. To the right of the screen are the monitor control keys, which you can use to perform setup functions, such as adjusting alarm limits and enabling or disabling alarms.



Alarm System

Active alarm messages are presented on the central alarm display, which is located on the upper half of the left-hand display screen. Messages are displayed in three separate windows—WARNING, CAUTION, or ADVISORY—depending on the urgency of the alarm. In addition, each type of alarm has its own specific audible alarm signal.

The following table describes each type of alarm. The alarms are listed in the table in the same order that they are shown on the screen.

Type of Alarm	Warning	Caution	Advisory
Priority	Highest	Second	Lowest
Audible Signal	Continuously repeating tone pattern	Intermittently repeating tone pattern	A single tone or no sound at all, depending on the urgency
Response Required	Immediate	Prompt	Awareness

NOTE: The Narkomed 2B may also serve as an alarm interface for external devices that adhere to the NAD Vitalink protocol. For information about alarms associated with a Vitalink device, see the documentation for that device.

Alarm Display

In each alarm window, messages are listed in order of occurrence, with the most recent at the bottom of the list. When a new alarm condition occurs, an arrow appears to its left. If the alarm condition creating this message is then resolved, the arrow disappears and does not reappear until the occurrence of a new alarm condition.

If the number of alarms in a category exceeds the space provided in that category's window, additional alarm messages are retained in the monitor's memory until space is available (that is, when displayed alarm conditions are resolved).

NOTE: The last space at the bottom of the Advisories window in the central alarm display is reserved for the SILENCE message. The SILENCE message indicates the time remaining in the Audio Silence period.

Alarm Signal

The Narkomed 2B annunciates only the highest-priority, currently active alarm. Lower-priority alarms are temporarily suppressed to minimize the confusion caused by simultaneous alarms. To temporarily silence audible alarms, you can use the Alarm Silence key on the control key panel (labeled with a crossed-out speaker).

If the primary speaker on the Narkomed 2B fails, a backup speaker is activated. The backup speaker has a tinny sound to distinguish it from the primary speaker. Another indication of the failure of the primary speaker is the appearance of the Advisory message SPEAKER FAIL on the central alarm display.

Ventilation Alarms

When the system power switch is turned to the ON position, the respiratory volume monitor's low minute volume and apnea volume alarms are automatically disabled to allow machine setup without nuisance alarms. The breathing pressure apnea alarm is also disabled to avoid a spurious alarm with a spontaneously breathing patient. An interlock with the ventilator ensures that when the ventilator is turned on, the alarms are automatically enabled. The respiratory and apnea volume alarms can also be manually enabled with the VOLUME ALARMS DISABLE key. The breathing pressure apnea alarm can be manually enabled with the APNEA ALARM DISABLE key.

Manual Sphygmomanometer (optional)

Noninvasive blood pressure can be measured with the manual sphygmomanometer. Several cuff sizes are available to accommodate varying patient requirements.

Section 2
General Description

O.R. Data Manager® (optional)

The O.R. Data Manager is an electronic data management system for acquiring, storing and retrieving information. It consists of a central processing unit with disk drive and a keyboard for entering and editing data. The O.R. Data Manager creates an electronic anesthesia record from information automatically recorded by the monitoring system and from input from the keyboard (such as patient data, events, drugs, and other case-related information), as well as interfaced monitors such as the Vitalert® 3000.

In addition to creating anesthesia records, the O.R. Data Manager can display case information in the form of a graph and can print anesthesia records to a disk or laser printer.

For more information, see the O. R. Data Manager manuals.

Section 3
Daily Checkout

Daily Checkout Procedure

Before operating the Narkomed 2B, the following checkout procedure must be performed to make sure the machine is ready for use. This is a recommended procedure. Follow your institution's policies for specific checkout procedures. If the anesthesia system fails any procedures identified by an asterisk (*), do not use the machine. Contact a North American Dräger qualified technical service representative for inspection of the unit.

NOTE: Do not insert any additional components into, or modify, the anesthesia system after the checkout procedure is started.

Initial Setup and Verification

1. Enter the serial number located on the right rear leg into the anesthesia record.

2. Make sure there is a valid inspection sticker on the back of the machine indicating that the anesthesia machine was serviced and inspected by a North American Dräger qualified technical service representative.

3. Verify that a cylinder wrench is tethered to the back of the machine next to one of the cylinders.

4. If the anesthesia machine is not already plugged in, connect the electrical power cable to an active AC outlet that accepts and properly grounds the power cable. **Do not** use "cheater" plugs. The term "cheater" plug implies any and all electrical plugs or other devices that can inhibit or prohibit the proper grounding of the anesthesia machine.

System Software Diagnostics

*5. Turn the SYSTEM POWER switch to the ON position. Wait for the machine to complete its diagnostic checks. Make sure the system is functional.

Battery Power Verification

*6. Check the reserve battery power. Remove the power plug from the outlet. Press the BATTERY TEST button on the main switch panel. The green indicator to the left of the test button must light. The yellow BATTERY LOW indicator must remain unlit. Plug the power cable back into the electrical outlet.

NOTE: This test assumes that the anesthesia machine has been plugged in for 16 hours. The battery charging system works only when the machine is connected to an active AC power source. The charging system takes about 16 hours to charge a fully discharged battery.

Section 3
Daily Checkout

Emergency Ventilation Equipment Verification

*7. Verify that backup ventilation equipment is available and functional.

High Pressure System Verification

*8. Check the oxygen cylinder supplies.

A. Disconnect all pipeline gas supply hoses and drain the system.

B. Close the oxygen cylinder valve and remove the cylinder from the yoke. Verify that there is one cylinder gasket and there are two index pins. Verify that the cylinder matches the yoke label. Place the cylinder back in its yoke.

C. Open an oxygen cylinder and check the cylinder pressure gauge. A full oxygen cylinder registers about 1900 psi. Replace any cylinder with pressure less than 1000 psi. To check for a high pressure leak, close the cylinder and observe the cylinder pressure gauge for a prominent decrease in the pressure.

D. If the machine is equipped with dual oxygen yokes, repeat these procedures for the other cylinder yoke.

*9. Check the nitrous oxide cylinder supplies.

A. Close the nitrous oxide cylinder valve and remove the cylinder from the yoke. Verify that there is one cylinder gasket and there are two index pins. Verify that the cylinder matches the yoke label. Place the cylinder back in its yoke.

B. Open the nitrous oxide flow control valve until the nitrous oxide pipeline and cylinder pressure gauges indicate zero pressure. Open a nitrous oxide cylinder and check the cylinder pressure gauge. A full nitrous oxide cylinder registers about 745 psi. Replace any cylinder with a pressure less than 600 psi. To check for a high pressure leak, close the cylinder and observe the cylinder pressure gauge for a prominent decrease in the pressure.

C. If the machine is equipped with dual nitrous oxide cylinder yokes, repeat these procedures for the other cylinder yoke.

*10. Check additional (optional) gas cylinder supplies.

A. With the cylinder closed, open the flow control valve of the associated gas until the cylinder and pipeline pressure gauges (air only) indicate zero pressure.

B. Close the cylinder valve and remove the cylinder from the yoke. Verify that there is one cylinder gasket and there are two index pins. Verify that the cylinder matches the associated yoke label. Place the cylinder back in its yoke.

C. Open the associated flow control valve until the cylinder pressure gauges indicate zero pressure. Open the cylinder and check the cylinder pressure gauge. Replace the cylinder if its contents are insufficient for the intended procedure. To check for a high pressure leak, close the cylinder and observe the cylinder pressure gauge for a prominent decrease in the pressure.

NOTE: After testing all of the gas circuits, drain the oxygen circuit by closing the oxygen cylinder and actuating the oxygen flush button on the front of the anesthesia machine. Hold the button in until the pressure gauges indicate no pressure.

The following table shows the full and minimum pressures (E-size cylinders at 70°F, 21°C) for all gases available for the anesthesia machine.

GAS	PSI - FULL*	PSI - MIN
Air	1900	1000
Carbon Dioxide	838	600
Oxygen-Helium	1900	1000
Nitrous Oxide	745	600
Oxygen	1900	1000

*typical full load

Section 3
Daily Checkout

Pipeline Supply System Verification

*11. Pipeline Supply Verification

A. Inspect the supply hoses for cracks or wear.

B. Connect the appropriate hospital pipeline supply hoses from the wall outlet fittings to the pipeline inlet connectors.

C. Check for sufficient pipeline pressure readings for each gas on the pipeline pressure gauges located below the flow control valves. The pressure for each gas must be between 50–55 psi. Open the flow control valve for each gas to a moderate value. The pressure indicated at the pipeline pressure gauge must not decrease more than 5 psi.

D. Verify that the correct gases are supplied to the anesthesia machine inlets.

Low Pressure System Verification

*12. Vaporizer Verification

A. Check for sufficient supply of liquid anesthetic in the vaporizer(s). The liquid level indicated in the vaporizer sight glass must be between the minimum and maximum markings.

B. Make sure the fill and drain valves are completely closed.

C. Check the vaporizer exclusion device, which prevents more than one vaporizer from being activated simultaneously. Make sure that when one vaporizer handwheel is turned to a setting greater than 0, the others remain locked in their 0 positions. Test all of the vaporizer positions. Then, turn all vaporizers to the 0 position.

System Gas Circuit Verification

*13. Check the flowmeters. Adjust the flow control knob for each gas and verify the proper operation of the corresponding flowmeters. The float must move freely over the full range of each flowmeter.

Oxygen Monitor Calibration

*14. Calibrate the oxygen monitor by exposing the sensor to ambient air and activate the calibration key. (See *Operation - Oxygen Monitoring* “Calibrating the Oxygen Sensor” in Section 5 for more information.)

A. Place the oxygen sensor securely in the sensor mount.

B. Verify that the correct gas concentrations are supplied to the anesthesia system from the supply cylinders.

C. Close the cylinder supplies and deplete the pressure from the system.

OFPD Verification

*15. Check the oxygen failure protection device. With all gases available on the machine set to a flow of about 4 l/min, close the oxygen supply by disconnecting the oxygen pipeline supply hose and closing the oxygen cylinder(s). The flow of all other gases indicated by their flowmeters must decrease in proportion to the decrease in oxygen flow and eventually shut off.

ORC Verification

*16. Check the function of the ORC. With the nitrous oxide flow control valve open to a flow of 10 l/min, vary the oxygen flow with the oxygen flow control valve. The nitrous oxide flow indicated on the nitrous oxide flowmeter must automatically vary in response to the adjustment of the oxygen flow control valve.

The ORC must maintain a fresh gas oxygen/nitrous oxide flow ratio of at least 25 ±4 % oxygen.

NOTE: When the nitrous oxide flow control valve is open and oxygen is flowing at a minimum rate (150–200 ml/min), nitrous oxide flows at approximately 500 ml/min.

Oxygen Flush Verification

*17. Check the oxygen flush:

A. Press the oxygen flush button and listen for an audible gas flow sound, accompanied by a marked increase in oxygen concentration in the breathing system.

B. Check the delivered oxygen concentration. Repeatedly flush the patient breathing system by pressing the oxygen flush button. Open the oxygen flow control valve to a flow of 8 l/min and close the other flow control valves. The oxygen measurement display area should indicate 97% to 100% oxygen concentration.

Fresh Gas Verification

*18. Make sure all vaporizers are closed. Open the oxygen flow control valve to an 8 l/min flow and close all other flow control valves. Sniff the gas coming from the fresh gas common outlet. There should be no noticeable odor.

Bain Circuit Adapter Verification

*19. Verify that the inner tube of the Bain circuit is intact and not occluded. First deliver a flow of oxygen to the Bain circuit through the fresh gas hose. Then occlude the inner tube of the Bain circuit. The oxygen flowmeter float should drop in response to the occlusion.

As an alternate test, press the oxygen flush button with the Bain circuit's patient port open to the atmosphere. The high flow of gas through the Bain circuit's inner tube will draw in gas from the outer tube. As a result, the breathing bag should deflate. If the breathing bag does not deflate or it inflates, the fresh gas hose or inner tube may be improperly connected.

Absorber System Verification

*20. To check the absorber system:

A. Check the hose connections in the breathing system.

B. Make sure the fresh gas hose of the breathing system is securely connected to the fresh gas outlet.

C. Make sure a 22 mm patient breathing circuit is connected between the inspiratory and expiratory valves on the absorber.

D. Make sure a 22 mm breathing hose is connected between the ventilator hose terminal and the manual/automatic selector valve breathing hose terminal.

E. Make sure a breathing bag of proper capacity and appropriate construction is connected to the breathing bag terminal of the breathing system.

F. Make sure the breathing pressure pilot line is properly connected between the BREATHING PRESSURE interface and either the absorber quick-connect fitting or the appropriate fitting at or near the patient Y-piece.

G. Make sure the oxygen sensor and respiratory volume sensor are properly installed.

*21. Make sure the absorber canisters are filled with CO_2 absorbent. Consult the absorbent manufacturer's literature for information on what signs to expect when the absorbent is exhausted. Replace the absorbent when it appears exhausted. Make sure that the color change represents the absorbent's true state of depletion and is not due to regeneration after a rest period. Flushing the anesthesia machine continuously with 100% oxygen for at least one minute before the first case of the day is recommended.

Remove accumulated absorbent dust and water from the absorber dust cup.

WARNING: Absorbent is caustic and is a strong eye, skin, and respiratory tract irritant. When emptying the absorber dust cup, take care not to spill its caustic contents.

NOTE: When changing the CO_2 absorbent, take care not to chip or crack the absorbent canister. Check the canister for signs of damage, especially along the rim, before reinstallation.

22. Close all vaporizers and flow control valves. Check for free gas passage in the patient breathing system. Wear a surgical mask to inhale and exhale through the breathing system (each limb individually, if possible). Verify the unidirectional flow in each limb and then reconnect the tubing.

APL Valve

*23. Check the APL valve to be sure it can relieve excess gas from the breathing system into the scavenger system.

To check the APL valve's flow resistance:

A. Set the manual/automatic selector valve to BAG.

B. Remove the bag from the swivel arm bag mount.

C. Interconnect the 22 mm ports of the inspiratory and expiratory valves with a 22 mm hose.

D. Completely open the APL valve by turning the control knob fully counterclockwise to its stop position.

E. Turn the SYSTEM POWER switch to ON.

F. Open the oxygen flow control valve to a flow of 8 l/min.

G. Occlude the bag mount opening and watch for a pressure increase on the breathing system pressure gauge. This pressure increase must not exceed 3 cmH_2O.

Breathing System Leak Test

24. Perform a breathing and fresh gas delivery system pressure test. This test detects leaks from the patient breathing system and fresh gas delivery system.

To perform the test:

A. Close all flow control valves on the anesthesia machine.

B. Turn the SYSTEM POWER switch to the STANDBY position.

C. Turn the vaporizers to 0% concentration.

D. Interconnect the 22 mm ports of the inspiratory and expiratory valves with a 22 mm breathing hose.

E. Set the manual/automatic selector valve to BAG.

F. Close the APL valve by turning the knob fully clockwise to its stop position.

G. Check that the breathing pressure gauge is on 0.

H. Attach the supplied test terminal to the breathing bag mount.

I. Connect a sphygmomanometer squeeze bulb (available from North American Dräger) to the hose barb on the test terminal.

J. Pump the squeeze bulb by hand until the breathing system pressure gauge indicates pressure of at least 50 cmH_2O (not to exceed 80 cmH_2O).

K. Observe the pressure drop at the breathing system pressure gauge. When the pressure is at 50 cmH_2O, begin counting seconds. The pressure must not drop more than 20 cmH_2O in 30 seconds.

Scavenger System

*25. Verify the performance of the scavenger system.

To test the open reservoir scavenger system:

A. Make sure a 19 mm scavenger hose is connected between the ventilator relief valve and the scavenger interface.

B. Make sure a 19 mm scavenger hose is connected between the APL valve on the absorber and the 19 mm hose terminal on the back of the absorber pole.

C. Make sure a 19 mm scavenger hose is connected between the bottom of the absorber pole and the scavenger interface.

D. Check for moisture accumulation in the breathing and scavenger hoses. Remove any moisture found.

E. Verify the safe performance of the open reservoir scavenging system. With the scavenging system properly installed and operating, test for positive and negative pressure relief.

To test for negative pressure relief:

F. Connect a vacuum hose to the DISS threaded terminal on the left-hand side of the scavenger (or attach a wall suction hose onto the adapter's hose-barb fitting).

G. Short-circuit the absorber's inspiratory and expiratory valves with a 22 mm breathing hose.

H. Set the absorber's manual/automatic selector valve to BAG.

I. Turn the APL valve control knob fully counterclockwise.

J. Verify that the suction waste gas disposal system is active.

K. Adjust the scavenger needle valve to a flowmeter indication between the two white lines.

L. Close all flow control valves on the anesthesia system.

M. Occlude the absorber breathing bag terminal and observe the breathing pressure gauge on the absorber. The gauge should indicate only a negligible negative pressure (no lower than -0.5 cmH_2O).

To test for positive pressure relief:

N. Perform steps A through E.

O. If the system is equipped with a PEEP valve, turn the PEEP valve control knob fully counterclockwise to its lowest setting.

P. Adjust the scavenger needle valve to a completely closed position by turning it fully clockwise.

Q. Open the oxygen flow control valve to a flow of 10 l/min and occlude the absorber breathing bag terminal.

R. The flow of oxygen must now exit through the relief ports located on top of the canister. The absorber system's breathing pressure gauge must indicate a pressure less than 5 cm H_2O.

S. After the test, adjust the scavenger needle valve to a flowmeter indication halfway between the two white lines.

To test the scavenger interface for passive systems:

A. Make sure a 19 mm scavenger hose is connected between the ventilator relief valve and the scavenger interface.

B. Make sure a 19 mm scavenger hose is connected between the APL valve on the absorber and the 19 mm hose terminal on the back of the absorber pole.

C. Make sure a 19 mm scavenger hose is connected between the bottom of the absorber pole and the scavenger interface.

D. Check for moisture accumulation in the breathing and scavenger hoses. Remove any moisture found.

E. Short circuit the absorber's inspiratory and expiratory valves with a 22 mm breathing hose.

F. Set the absorber's manual/automatic selector valve to AUTO.

G. If the system is equipped with a PEEP valve, turn the PEEP valve control knob fully counterclockwise to its lowest setting.

H. Open the oxygen flow control valve to a flow of 10 l/min and occlude the 19 mm scavenger terminal labeled EXHAUST.

I. After the ventilator bellows inflates, the flow of oxygen exits the system through the positive pressure safety relief valve. At this point, the absorber system's breathing pressure gauge must indicate a pressure of less than 10 cmH_2O.

Manual and Automatic Ventilation Systems

*26. Test the ventilator.

A. Check for proper pressure and flow at the Y-piece during the inspiratory and expiratory phases. Turn the SYSTEM POWER switch and ventilator power switch to their ON positions. Place the manual/automatic selector valve in the AUTO position. Adjust the oxygen flow control valve to a 3 l/min flow. Set the ventilator frequency to 3 BPM, the I:E ratio to 1:2, and the tidal volume to about 1 liter. (If testing the Pediatric Bellows or Adult/Pediatric Bellows, adjust the tidal volume to 200 ml.)

Adjust the ventilator inspiratory flow control to the maximum of the “low” zone on the flow gauge. Occlude the patient side of the Y-piece. Fill the ventilator bellows by pressing the oxygen flush button. Observe the breathing system pressure gauge as the ventilator cycles.

The pressure gauge must indicate a pressure over 30 cmH_2O when the bellows completes its downward travel. The pressure should not exceed 3 cmH_2O at the end of the expiratory phase when the bellows completes its upward travel.

B. If the system is equipped with a PEEP valve, verify the PEEP valve’s performance. Attach a breathing bag to the patient Y-piece with an appropriate adapter such as an NAD combination mask elbow with a 22 mm male fitting for the breathing bag and 15 mm male fitting for the Y-piece. With the manual/automatic selector valve in the AUTO position, set the ventilator to the preferred frequency.

Set the PEEP bypass switch to the PEEP ON position. Then adjust the PEEP valve to different values and observe the breathing system pressure gauge to verify performance. Turn the PEEP valve control knob fully counterclockwise to its lowest setting after the test is completed. Set the PEEP bypass switch to the PEEP OFF position.

Monitors

27. Check the alarm limit settings. The monitor alarm limits are automatically set to a default configuration when the SYSTEM POWER switch is turned on. Check these settings and adjust them if necessary. Alarm limits can be adjusted at the beginning of—or during—a procedure. Also, make sure that any external monitors (if any) are connected properly and that the alarms sound through the anesthesia machine’s central audio annunciator.

*28. Test the alarm functions for all monitors. Simulate alarm conditions and check for appropriate alarm signals.

System Flush

29. Flush the system with 100% oxygen by pressing the oxygen flush button.

Fresh Gas Oxygen Sensor Adapter Option Verification

30. If the optional fresh gas oxygen sensor adapter is installed, make sure the fresh gas hose connection is intact and not occluded. Verify that the oxygen analyzer is properly calibrated. (See *Operation - Oxygen Monitoring* "Calibrating the Oxygen Sensor" in Section 5 for more information.) When removing the oxygen sensor during calibration, insert the oxygen sensor port plug into the fresh gas adapter port.

Final Position

31. When the daily checkout procedure is complete, verify that:

A. all vaporizers are off (the handwheels are set to zero)

B. the APL Valve is open (fully counterclockwise)

C. the manual/automatic switch is set to BAG

D. all flowmeters indicate 0 (or minimum)

E. the patient suction is level adequate

F. the breathing system is ready to use (the bag is in place and all hoses are connected properly)

Section 4
Preuse Checkout

Preuse Checkout Procedure

Perform the following abbreviated checkout procedure when the Narkomed 2B is used in successive cases. It may be performed only after the initial daily checkout procedure given in Section 3 was performed. This is a recommended procedure. Follow your institution's policies regarding specific checkout procedures. If the anesthesia system fails any procedures identified by an asterisk (*), do not use the machine. Contact a North American Dräger qualified technical service representative for inspection of the unit.

NOTE: Do not insert any additional components into or modify the anesthesia system after the checkout procedure is started.

Reserve Power Verification

*1. Check the reserve battery power. Make sure that the SYSTEM POWER switch is turned to the ON position. Remove the power plug from the outlet. Press the BATTERY TEST button on the main switch panel. The green indicator to the left of the test button must light. The yellow BATTERY LOW indicator must remain unlit. Plug the power cable back into the electrical outlet.

NOTE: This test assumes that the anesthesia machine has been plugged in for 16 hours. The battery charging system works only when the machine is connected to an active AC power source. The charging system takes about 16 hours to charge a fully discharged battery.

Bain Circuit Adapter Verification

*2. Verify that the inner tube of the Bain circuit is intact and not occluded. First deliver a flow of oxygen to the Bain circuit through the fresh gas hose. Then occlude the inner tube of the Bain circuit. The oxygen flowmeter float should drop in response to the occlusion.

As an alternate test, press the oxygen flush button with the Bain circuit's patient port open to the atmosphere. The high flow of gas through the Bain circuit's inner tube will draw in gas from the outer tube. As a result, the breathing bag should deflate. If the breathing bag does not deflate or it inflates, the fresh gas hose or inner tube may be improperly connected.

Absorber System Verification

*3. To check the absorber system:

A. Check the hose connections in the breathing system.

B. Make sure the fresh gas hose of the breathing system is securely connected to the fresh gas outlet.

C. Make sure a 22 mm patient breathing circuit is connected between the inspiratory and expiratory valves on the absorber.

D. Make sure a 22 mm breathing hose is connected between the ventilator hose terminal and the manual/automatic selector valve breathing hose terminal.

E. Make sure a breathing bag of proper capacity and appropriate construction is connected to the breathing bag terminal of the breathing system.

F. Make sure the breathing pressure pilot line is properly connected between the BREATHING PRESSURE interface and either the absorber quick-connect fitting or the appropriate fitting at or near the patient Y-piece.

G. Make sure the oxygen sensor and respiratory volume sensor are properly installed.

*4. Make sure the absorber canisters are filled with CO_2 absorbent. Consult the absorbent manufacturer's literature for information on what signs to expect when the absorbent is exhausted. Replace the absorbent when it appears exhausted. Make sure that the color change represents the absorbent's true state of depletion and is not due to regeneration after a rest period. Flushing the anesthesia machine continuously with 100% oxygen for at least one minute before the first case of the day is recommended.

Remove accumulated absorbent dust and water from the absorber dust cup.

WARNING: Absorbent is caustic and is a strong eye, skin, and respiratory tract irritant. When emptying the absorber dust cup, take care not to spill its caustic contents.

NOTE: When changing the CO_2 absorbent, take care not to chip or crack the absorbent canister. Check the canister for signs of damage, especially along the rim, before reinstallation.

5. Close all vaporizers and flow control valves. Check for free gas passage in the patient breathing system. Wear a surgical mask to inhale and exhale through the breathing system (each limb individually, if possible). Verify the unidirectional flow in each limb and then reconnect the tubing.

APL Valve

*6. Check the APL valve to be sure it can relieve excess gas from the breathing system into the scavenger system.

To check the APL valve's flow resistance:

A. Set the manual/automatic selector valve to BAG.

B. Remove the bag from the swivel arm bag mount.

C. Interconnect the 22 mm ports of the inspiratory and expiratory valves with a 22 mm hose.

D. Completely open the APL valve by turning the control knob fully counterclockwise to its stop position.

E. Turn the SYSTEM POWER switch to ON.

F. Open the oxygen flow control valve to a flow of 8 l/min.

G. Occlude the bag mount opening and watch for a pressure increase on the breathing system pressure gauge. This pressure increase must not exceed 3 cmH_2O.

Breathing System Leak Test

7. Perform a breathing and fresh gas delivery system pressure test. This test detects leaks from the patient breathing system and fresh gas delivery system.

To perform the test:

A. Close all flow control valves on the anesthesia machine.

B. Turn the SYSTEM POWER switch to the STANDBY position.

C. Turn the vaporizers to 0% concentration.

D. Interconnect the 22 mm ports of the inspiratory and expiratory valves with a 22 mm breathing hose.

E. Set the manual/automatic selector valve to BAG.

F. Close the APL valve by turning the knob fully clockwise to its stop position.

G. Check that the breathing pressure gauge is on 0.

H. Attach the supplied test terminal to the breathing bag mount.

I. Connect a sphygmomanometer squeeze bulb (available from North American Dräger) to the hose barb on the test terminal.

J. Pump the squeeze bulb by hand until the breathing system pressure gauge indicates pressure of at least 50 cmH_2O (not to exceed 80 cmH_2O).

K. Observe the pressure drop at the breathing system pressure gauge. When the pressure is at 50 cmH_2O, begin counting seconds. The pressure must not drop more than 20 cmH_2O in 30 seconds.

Scavenger System

*8. Verify the performance of the scavenger system.

To test the open reservoir scavenger system:

A. Make sure a 19 mm scavenger hose is connected between the ventilator relief valve and the scavenger interface.

B. Make sure a 19 mm scavenger hose is connected between the APL valve on the absorber and the 19 mm hose terminal on the back of the absorber pole.

C. Make sure a 19 mm scavenger hose is connected between the bottom of the absorber pole and the scavenger interface.

D. Check for moisture accumulation in the breathing and scavenger hoses. Remove any moisture found.

E. Verify the safe performance of the open reservoir scavenging system. With the scavenging system properly installed and operating, test for positive and negative pressure relief.

To test for negative pressure relief:

F. Connect a vacuum hose to the DISS threaded terminal on the left-hand side of the scavenger (or attach a wall suction hose onto the adapter's hose-barb fitting).

G. Short-circuit the absorber's inspiratory and expiratory valves with a 22 mm breathing hose.

H. Set the absorber's manual/automatic selector valve to BAG.

I. Turn the APL valve control knob fully counterclockwise.

J. Verify that the suction waste gas disposal system is active.

K. Adjust the scavenger needle valve to a flowmeter indication between the two white lines.

L. Close all flow control valves on the anesthesia system.

M. Occlude the absorber breathing bag terminal and observe the breathing pressure gauge on the absorber. The gauge should indicate only a negligible negative pressure (no lower than -0.5 cmH_2O).

To test for positive pressure relief:

N. Perform steps A through E.

O. If the system is equipped with a PEEP valve, turn the PEEP valve control knob fully counterclockwise to its lowest setting.

P. Adjust the scavenger needle valve to a completely closed position by turning it fully clockwise.

Q. Open the oxygen flow control valve to a flow of 10 l/min and occlude the absorber breathing bag terminal.

R. The flow of oxygen must now exit through the relief ports located on top of the canister. The absorber system's breathing pressure gauge must indicate a pressure less than 5 cm H_2O.

S. After the test, adjust the scavenger needle valve to a flowmeter indication halfway between the two white lines.

To test the scavenger interface for passive systems:

A. Make sure a 19 mm scavenger hose is connected between the ventilator relief valve and the scavenger interface.

B. Make sure a 19 mm scavenger hose is connected between the APL valve on the absorber and the 19 mm hose terminal on the back of the absorber pole.

C. Make sure a 19 mm scavenger hose is connected between the bottom of the absorber pole and the scavenger interface.

D. Check for moisture accumulation in the breathing and scavenger hoses. Remove any moisture found.

E. Short circuit the absorber's inspiratory and expiratory valves with a 22 mm breathing hose.

F. Set the absorber's manual/automatic selector valve to AUTO.

G. If the system is equipped with a PEEP valve, turn the PEEP valve control knob fully counterclockwise to its lowest setting.

H. Open the oxygen flow control valve to a flow of 10 l/min and occlude the 19 mm scavenger terminal labeled EXHAUST.

I. After the ventilator bellows inflates, the flow of oxygen exits the system through the positive pressure safety relief valve. At this point, the absorber system's breathing pressure gauge must indicate a pressure of less than 10 cmH_2O.

Manual and Automatic Ventilation Systems

*9. Test the ventilator.

A. Check for proper pressure and flow at the Y-piece during the inspiratory and expiratory phases. Turn the SYSTEM POWER switch and ventilator power switch to their ON positions. Place the manual/automatic selector valve in the AUTO position. Adjust the oxygen flow control valve to a 3 l/min flow. Set the ventilator frequency to 3 BPM, the I:E ratio to 1:2, and the tidal volume to about 1 liter. (If testing the Pediatric Bellows or Adult/Pediatric Bellows, adjust the tidal volume to 200 ml.)

Adjust the ventilator inspiratory flow control to the maximum of the "low" zone on the flow gauge. Occlude the patient side of the Y-piece. Fill the ventilator bellows by pressing the oxygen flush button. Observe the breathing system pressure gauge as the ventilator cycles.

The pressure gauge must indicate a pressure over 30 cmH_2O when the bellows completes its downward travel. The pressure should not exceed 3 cmH_2O at the end of the expiratory phase when the bellows completes its upward travel.

B. If the system is equipped with a PEEP valve, verify the PEEP valve's performance. Attach a breathing bag to the patient Y-piece with an appropriate adapter such as an NAD combination mask elbow with a 22 mm male fitting for the breathing bag and 15 mm male fitting for the Y-piece. With the manual/automatic selector valve in the AUTO position, set the ventilator to the preferred frequency.

Set the PEEP bypass switch to the PEEP ON position. Then adjust the PEEP valve to different values and observe the breathing system pressure gauge to verify performance. Turn the PEEP valve control knob fully counterclockwise to its lowest setting after the test is completed. Set the PEEP bypass switch to the PEEP OFF position.

Monitors

10. Check the alarm limit settings. The monitor alarm limits are automatically set to a default configuration when the SYSTEM POWER switch is turned on. Check these settings and adjust them if necessary. Alarm limits can be adjusted at the beginning of—or during—a procedure. Also, make sure that any external monitors (if any) are connected properly and that the alarms sound through the anesthesia machine's central audio annunciator.

*11. Test the alarm functions for all monitors. Simulate alarm conditions and check for appropriate alarm signals.

System Flush

12. Flush the system with 100% oxygen by pressing the oxygen flush button.

Fresh Gas Oxygen Sensor Adapter Option Verification

13. If the optional fresh gas oxygen sensor adapter is installed, make sure the fresh gas hose connection is intact and not occluded. Verify that the oxygen analyzer is properly calibrated. (See *Operation - Oxygen Monitoring* "Calibrating the Oxygen Sensor" in Section 5 for more information.) When removing the oxygen sensor during calibration, insert the oxygen sensor port plug into the fresh gas adapter port.

Section 4
Preuse Checkout

Final Position

14. When the daily checkout procedure is complete, verify that:

    A. all vaporizers are off (the handwheels are set to zero)

    B. the APL Valve is open (fully counterclockwise)

    C. the manual/automatic switch is set to BAG

    D. all flowmeters indicate 0 (or minimum)

    E. the patient suction is level adequate

    F. the breathing system is ready to use (the bag is in place and all hoses are connected properly)

Section 5 - Operation
Gas Delivery System

Overview

The Narkomed 2B is a continuous flow anesthesia system with pneumatic circuitry for mixing and delivering gases and anesthetic agent vapor. The pneumatic system can deliver up to four gases and one anesthetic agent simultaneously. Oxygen and nitrous oxide are standard on all machines; available optional gases include air, carbon dioxide, and oxygen-helium (heliox). Up to three vaporizers can be mounted on the machine; available vaporizers are for halothane, enflurane, isoflurane, sevoflurane, and desflurane.

Connecting the Pipeline Gas Supply

Gas from the hospital pipelines enters the Narkomed 2B through hoses connected to indexed inlets located on the side of the flowmeter housing. Depending on the country's standards and regulations, the available inlets are Diameter-Indexed Safety System (DISS) inlets (body or nut fitting), or National Institute for Standards and Technology (NIST) inlets.

To connect a pipeline supply to the Narkomed 2B:

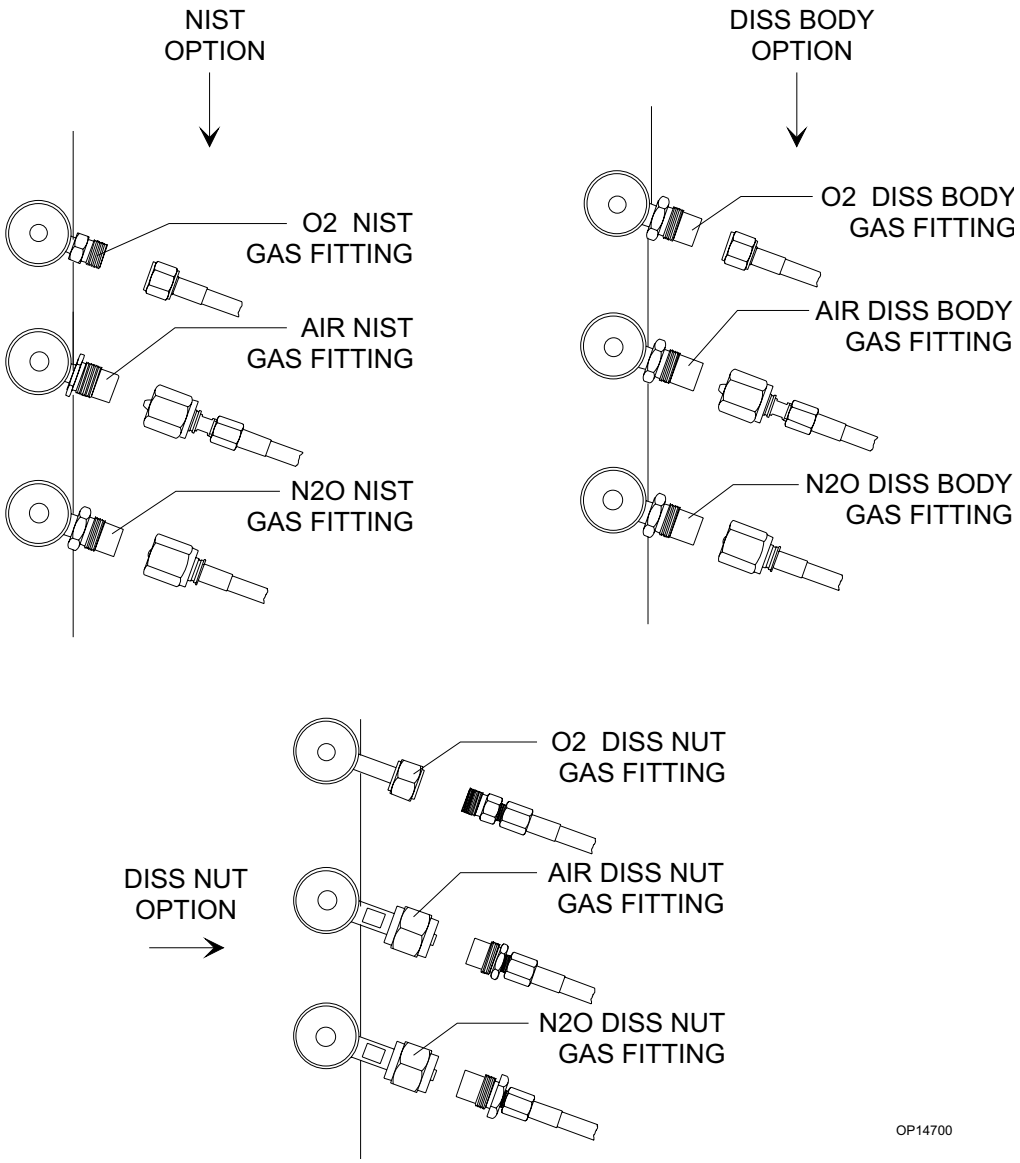
1. Connect the gas fitting on the supply hose to the corresponding gas fitting on the side of the flowmeter housing. Use a wrench to tighten the hex nut.

WARNING: Carefully check hoses each time you connect a machine to a wall or ceiling outlet to ensure that both ends of the hose are indexed for the same gas. Pipeline delivery hoses used between wall outlets and anesthesia machines have caused accidents when, during assembly, an oxygen fitting was placed on one end of the hose and a nitrous oxide fitting on the other end.

2. Connect the other end of the supply hose to the appropriate functioning hospital pipeline supplies.

3. Check the pipeline pressure gauge on the front of the Narkomed 2B for sufficient pipeline pressure (50-55 psi).

Section 5 - Operation
Gas Delivery System



Connecting the Gas Cylinders

When attaching a cylinder, make sure that only one washer is installed between the cylinder and the yoke gas inlet. Using multiple washers may compromise the pin-indexed safety system. Be sure to verify the integrity of both index pins whenever you install a new cylinder.

To connect a gas cylinder to its yoke:

1. Place a new washer on the seat of the yoke gas inlet connection.

WARNING: Use only one cylinder washer per yoke. Using more than one washer could cause leakage of the cylinder gas and compromise the pin indexing system.

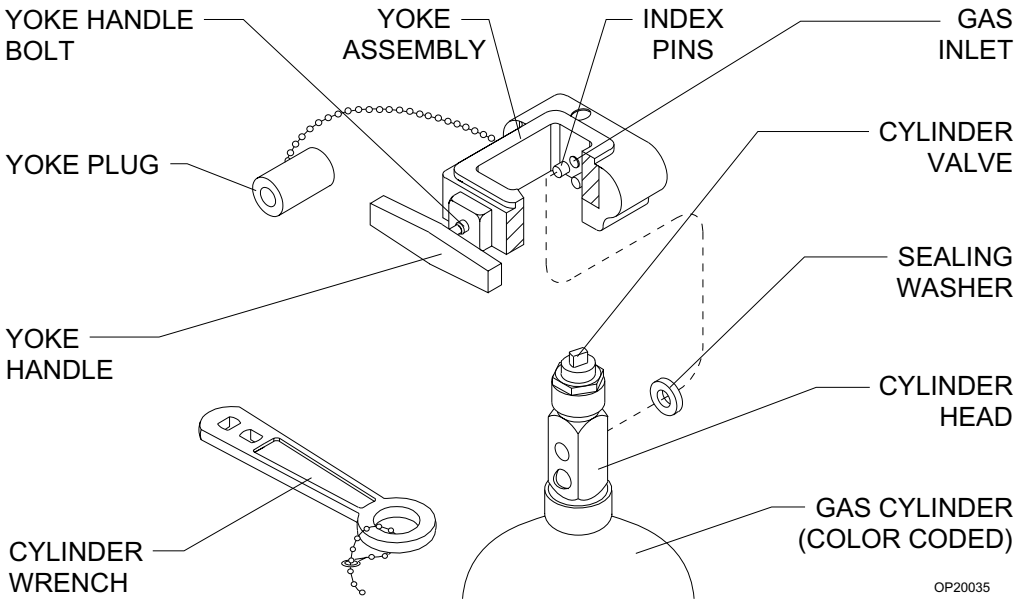
2. Verify the presence and integrity of the two index pins below the gas inlet.

WARNING: Check cylinder yokes for the presence of two index pins each time you attach a cylinder to the machine.

3. Insert the head of a gas cylinder with matching gas into the yoke from below, so that the gas outlet and indexing holes on the cylinder head are facing the gas inlet and indexing pins on the yoke assembly.

4. Engage the indexing holes with the index pins. Screw the yoke handle clockwise against the cylinder head, so that the point of the yoke handle bolt is aligned with the countersunk recess on the back of the cylinder head.

5. Verify that the sealing washer is in place, that the index pins are engaged, and that the cylinder hangs vertically. Tighten the handle securely.



Section 5 - Operation
Gas Delivery System

Connecting the Fresh Gas Hose

To connect the fresh gas hose, pull out the fresh gas locking bar located on the front of the Narkomed 2B to its extended position. Insert the 15 mm male fitting on the fresh gas hose into the 15 mm female terminal. Release the spring-loaded locking bar over the fitting, allowing it to "lock" the fitting into place.

WARNING: Do not pinch or kink the fresh gas hose leading from the fresh gas outlet to the absorber.

Adjusting the Gas Flow

To adjust the gas flow:

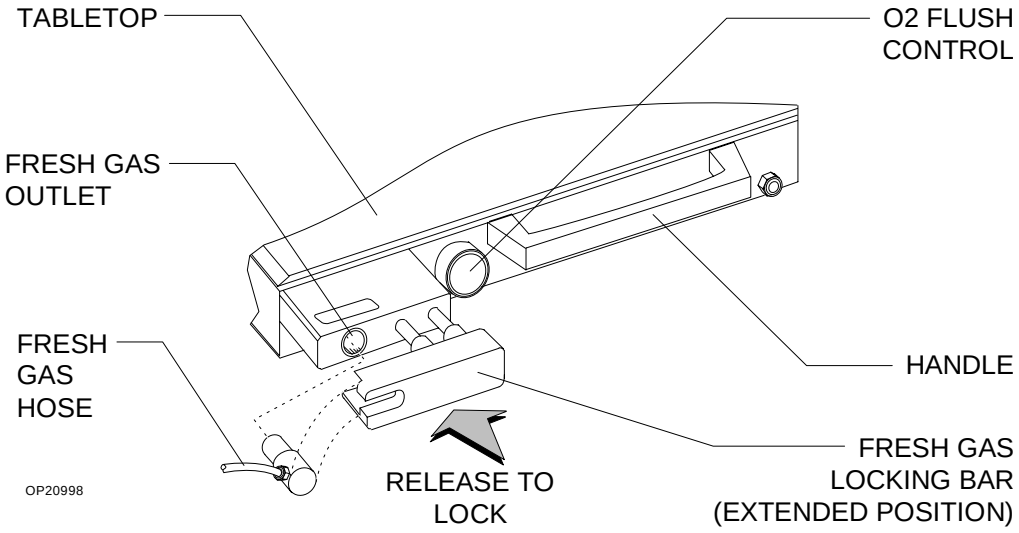
1. Turn the flow control knob located below the fine flowmeter tube for the gas you want to adjust. Turning the valve knob counterclockwise increases flow; turning the knob clockwise decreases flow.

2. As you adjust the flow control knob, observe the flow rate. Flow rate is indicated by the flowmeter scale reading at the center of the float.

CAUTION: The flow of oxygen cannot be completely shut off (see "Minimum Oxygen Flow" in "Section 2 - General Description"). Do not force the oxygen flow control knob past the zero stop in an effort to shut off the minimum flow; forcing the knob can damage the valve seat.

Using the Oxygen Flush

To use the oxygen flush, press the oxygen flush button, located on the front of the Narkomed 2B, for a few seconds. This introduces an unmetered flow of pure oxygen into the breathing circuit at a rate of about 55 l/min.



Overview

The Vapor 19.1 adds an anesthetic gas to the fresh gas stream by producing a precisely metered amount of the vapor of a particular liquid anesthetic. The vaporizer is installed in the fresh gas line upstream of the patient breathing system (semi-closed, semi-open system).

WARNING: The vaporizer must not be connected downstream of the fresh gas outlet of the anesthesia machine.

For low flow (fresh gas flows lower than 250 ml/min) or closed system anesthesia, breathing circuit concentrations may differ considerably from the vaporizer setting. When performing anesthesia with low flow or closed system techniques, it is essential to monitor inspiratory and expiratory anesthesia concentration, oxygen concentration, expiratory volume, and airway pressure in the circuit.

The carrier gases used must be dry and free of oil and dust. The limits for moisture are as follows:

- dew point of oxygen ≤ 5° C
- dew point of air ≤ 5° C
- water contents of nitrous oxide ≤ 2 mg/l

NOTE: For information on the Tec 6 desflurane vaporizer, refer to its instruction manual.

Filling Systems

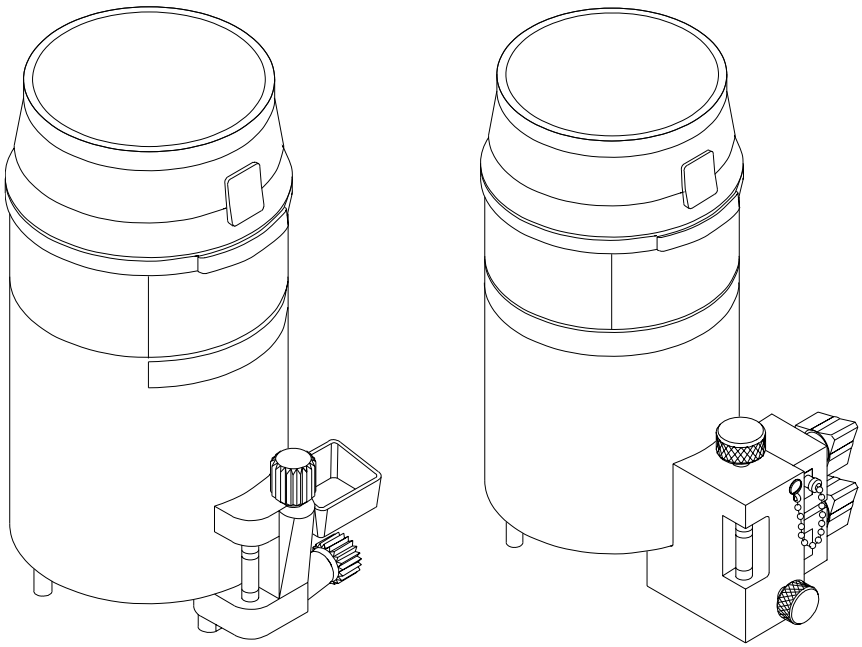
Two filling systems are available for the Vapor 19.1:

- Open funnel system
- Key indexed safety system

The following figure shows vaporizers with the two different types of available filling systems.

Section 5 - Operation
Vaporizer

OP10603



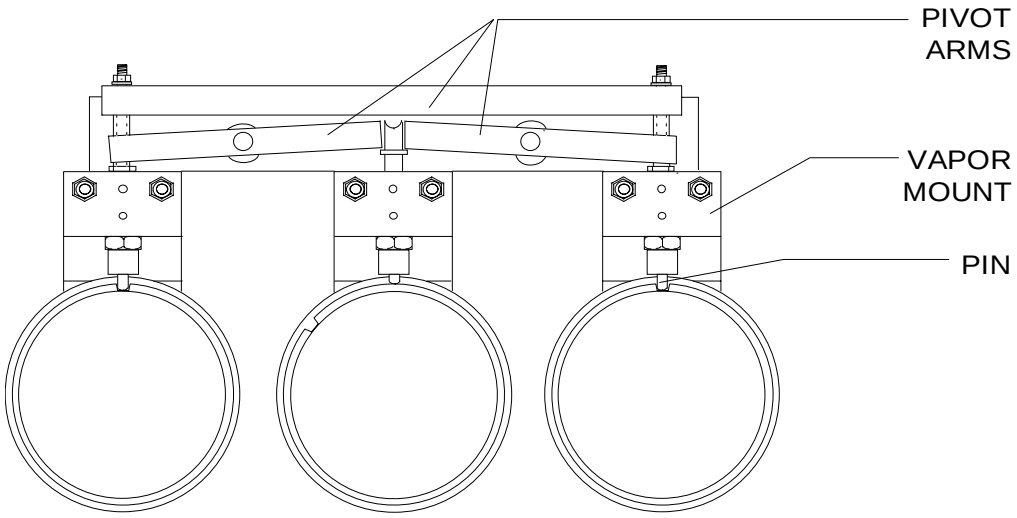
OPEN FUNNEL FILLER

KEY INDEXED
SAFETY SYSTEM

North American Dräger Exclusion System

A cam and lever exclusion (interlock) system incorporated into the vaporizer bank prevents more than one vaporizer from being activated at a time. The exclusion system requires all unused vaporizers to be locked in their zero percent positions.

WARNING: Only one vaporizer can be activated at a time. If the exclusion system permits simultaneous activation of more than one vaporizer, DO NOT use the anesthesia machine. Contact a North American Dräger qualified technical service representative for adjustment.



Operating the Vaporizers

Before each case, check the following items.

1. Make sure the vaporizer contains a sufficient amount of anesthetic agent as indicated in the sight glass.

2. Make sure the filling and draining valves are closed. For vaporizers with the key indexed safety system, make sure the sealing plug is properly fitted and locking screw is tight.

3. Make sure the handwheel is set to “0” (zero-point interlock) and that the button is engaged.

Turning the Vaporizer On

To turn the vaporizer on:

1. Adjust the fresh gas flow.

2. Turn the vaporizer handwheel to the desired anesthetic concentration. Do not set the handwheel between 0 and 0.2% volume concentration (0.3% volume with Enflurane Vapor). This part of the handwheel actuates the on/off switch and cannot be calibrated.

NOTE: After you turn on the vaporizer, activate the scavenger system to collect and remove vented gas from the operating room.

Turning the Vaporizer Off

To turn the vaporizer off, turn the vaporizer handwheel to “0” (zero-point interlock) and make sure the button engages. Do not interrupt the fresh gas flow until you have turned off the vaporizer.

NOTE: If you will not be using the vaporizer for a long period of time (longer than one month), or if the vaporizer will be removed from the anesthesia machine, drain the anesthetic agent from the vaporizer.

Filling the Vaporizer

Before filling a vaporizer, identify the filling system on the device as one of the following:

- Open funnel system
- Key indexed safety system

When you have identified the filling system, locate the appropriate procedure and read it entirely before filling the device.

WARNING: Do not inhale anesthetic vapors while filling the vaporizer. Uncontrolled inhalation of anesthetic vapors is injurious to health.

Before filling a vaporizer, note the expiration date of the anesthetic agent. Do not use anesthetics beyond the date of expiration.

CAUTION: Each vaporizer is specifically designed and calibrated for one particular anesthetic agent. Do not fill a vaporizer with any anesthetic other than the particular agent indicated on the vaporizer.

- The Isoflurane vaporizer must be filled with Isoflurane only (trade names: Forane, Forene, Aerrane).
- The Enflurane vaporizer must be filled with Enflurane only (trade names: Ethrane, Alyrane).
- The Halothane vaporizer must be filled with Halothane only (trade name: Fluothane).
- The Desflurane vaporizer must be filled with Desflurane only (trade name: Suprane).
- The Sevoflurane vaporizer must be filled with Sevoflurane only (trade name: Ultane).

Do not use a vaporizer that has been inadvertently filled with the wrong anesthetic. Drain the vaporizer and return the device to North American Dräger’s Technical Service Department.

Filling the Vaporizer During a Case

If you must fill the vaporizer during a case, be extremely careful. While fresh gas is flowing and the vaporizer is turned on, the vaporizing chamber is pressurized. DO NOT open the inlet valve (or the screw of the safety filling device) under these circumstances — liquid anesthetic may gush out. To safely add anesthetic agent while the machine is in use, depressurize the vaporizer by setting the handwheel to "0" (zero-point interlock); make sure the button engages in the locked position. Allow at least 5 seconds for the vaporizing chamber to depressurize, then use the appropriate procedure to add the anesthetic agent.

WARNING: The vaporizer handwheel must be set to "0" (zero-point interlock) before the vaporizer can be filled.

Filling Vaporizer With Open Funnel System

1. With the vaporizer in an upright position, turn the handwheel to "0" (zero-point interlock) and make sure the button engages in the locked position.

2. Make sure the filling spout is clean. To remove dust or other particles, use a clean, dry paper towel. Do not use water or other liquid cleaning solutions.

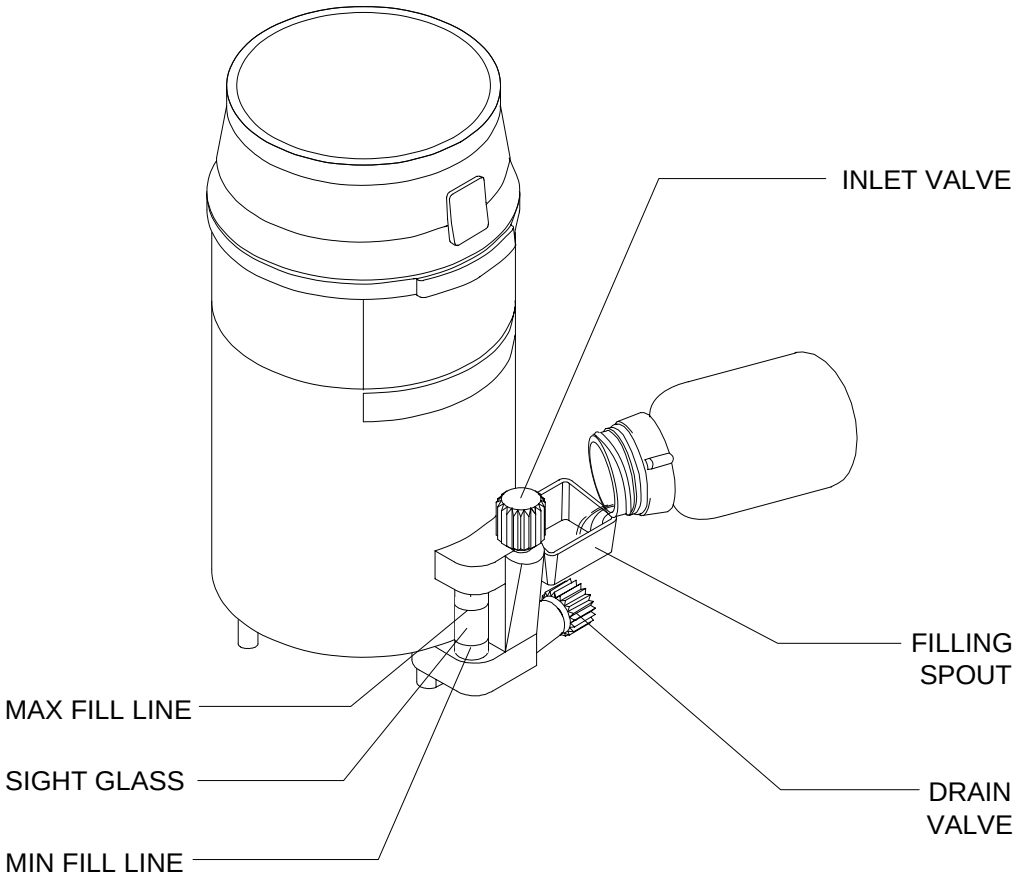
3. Make sure the drain valve is closed.

4. Open the inlet valve by turning it counterclockwise about three turns.

CAUTION: Be sure to fill the vaporizer in an upright position; filling the vaporizer in a tilted position may cause overfilling. Overfilling may cause the anesthetic concentration rate to be higher or lower than the handwheel setting.

5. Remove the cap from the anesthetic agent bottle. Check the sealing edge of the bottle for chipping or other damage. DO NOT use if damaged.

Section 5 - Operation
Vaporizer



6. With the vaporizer in an upright position, pour the anesthetic agent into the funnel. As you pour the agent, observe the level through the sight glass. Fill the vaporizer to the MAX mark and close the inlet valve.

   NOTE: The capacity of the vaporizer is approximately 140 cm^3 with wet wick, and approximately 200 cm^3 with dry wick.

7. After filling, check the level at the sight glass. When the vaporizer is in an upright position, the level must not exceed the MAX mark.

   If the vaporizer is inadvertently overfilled (MAX mark exceeded), drain the excess anesthetic. For information on draining the vaporizer, refer to “Draining Vaporizer with Open Funnel Spout” later in this section.

8. Place the cap back on the bottle.

Filling Vaporizer With Key Indexed Safety System

The key indexed safety system employs a matching assembly to prevent inadvertent use of the wrong agent in a Vapor 19.1 device. To fill a vaporizer with key indexed safety system, you must have the appropriate keyed bottle adapter for the anesthetic agent.

1. With the vaporizer in an upright position, turn the handwheel to “0” (zero-point interlock) and make sure the button engages in the locked position.

2. Remove the cap and seal from the anesthetic agent bottle. Check the sealing edge of bottle for chipping or other damage. DO NOT use if damaged.

3. Attach the keyed bottle adapter to the keyed collar on the bottle. Screw the parts together tightly to form an airtight seal.

4. Turn the filler port lock screw counterclockwise and remove the filler port plug from the filler port.

5. Insert the keyed adapter into the filler port of the vaporizer so that the two holes in the adapter face the Teflon seal surface of the filler port. Bend the filler tube so that the liquid level in the bottle is below the filler port. Adjust the plastic tubing to avoid kinks.

6. Turn the filler port lock screw clockwise to hold the adapter against the Teflon seal.

7. Open the filler valve by turning the knob counterclockwise two or three turns.

CAUTION: Be sure to fill the vaporizer in an upright position; filling the vaporizer in a tilted position may cause overfilling. Overfilling may cause the anesthetic concentration rate to be higher or lower than the handwheel setting.

8. Lift the bottle above the filler port level, avoiding kinks in the plastic tube. The liquid should begin flowing within 10 seconds after raising the bottle. If liquid does not begin to flow within 10 seconds, move the bottle below filler port level and raise it above the filler port again. (This allows any air trapped in the tubing to escape.) Repeat as necessary to start the flow.

9. Watch the sight glass while the vaporizer is filling, and close the filler valve when the liquid level reaches the lower of the two marks at the upper end of the sight glass. The lower mark is the FULL mark; the upper mark is the OVERFLOW mark.

   NOTE: The capacity of the vaporizer is approximately 140 cm^3 with wet wick, and approximately 200 cm^3 with dry wick.

10. Remove the adapter from the filler port.

11. Allow excess liquid to drain from the filler port.

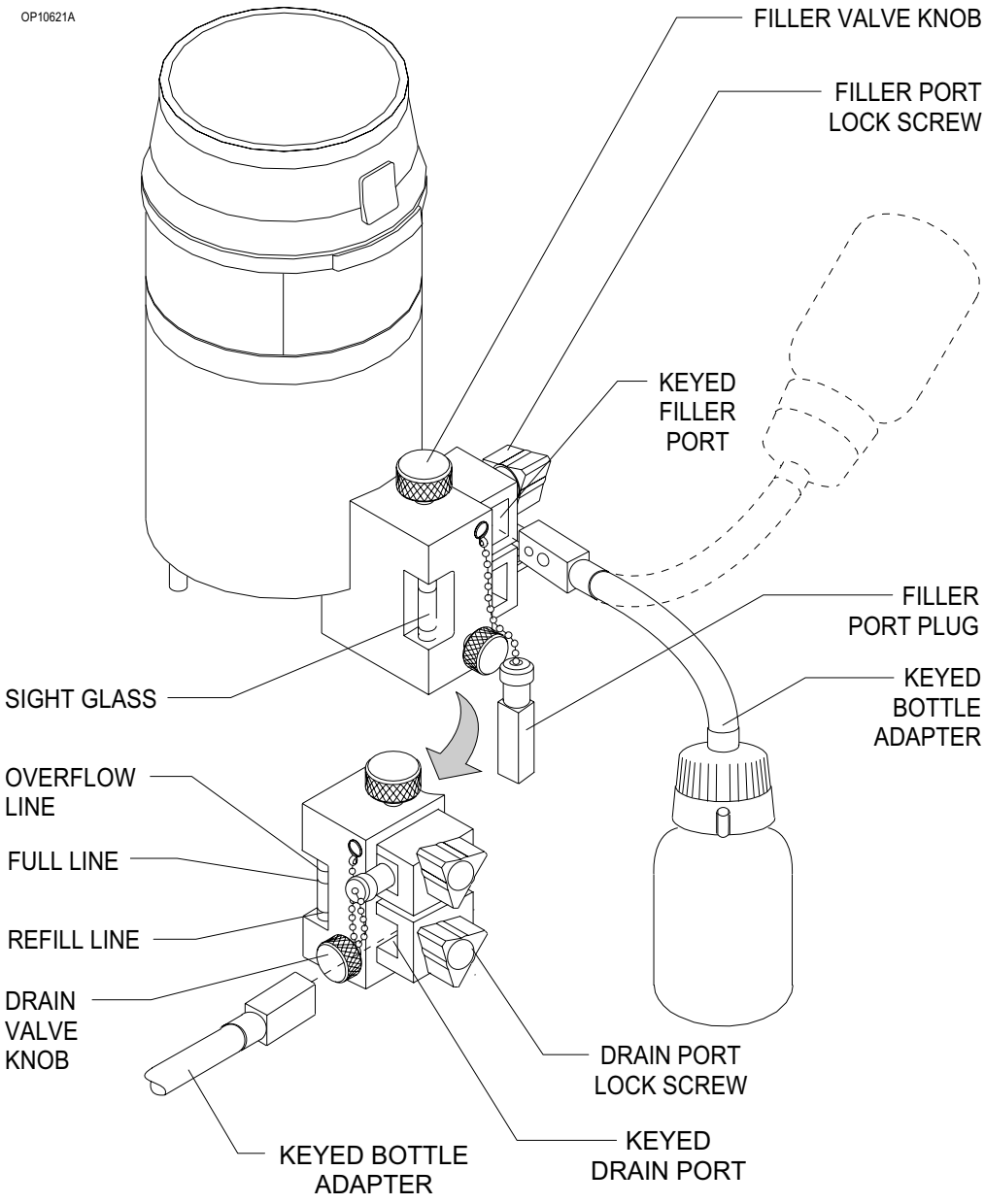
12. Fully insert the filler port plug in the filler port and tighten the plug in place by turning the lock screw clockwise.

13. After filling, check the level at the sight glass. When the vaporizer is in an upright position, the level must not exceed the FULL mark.

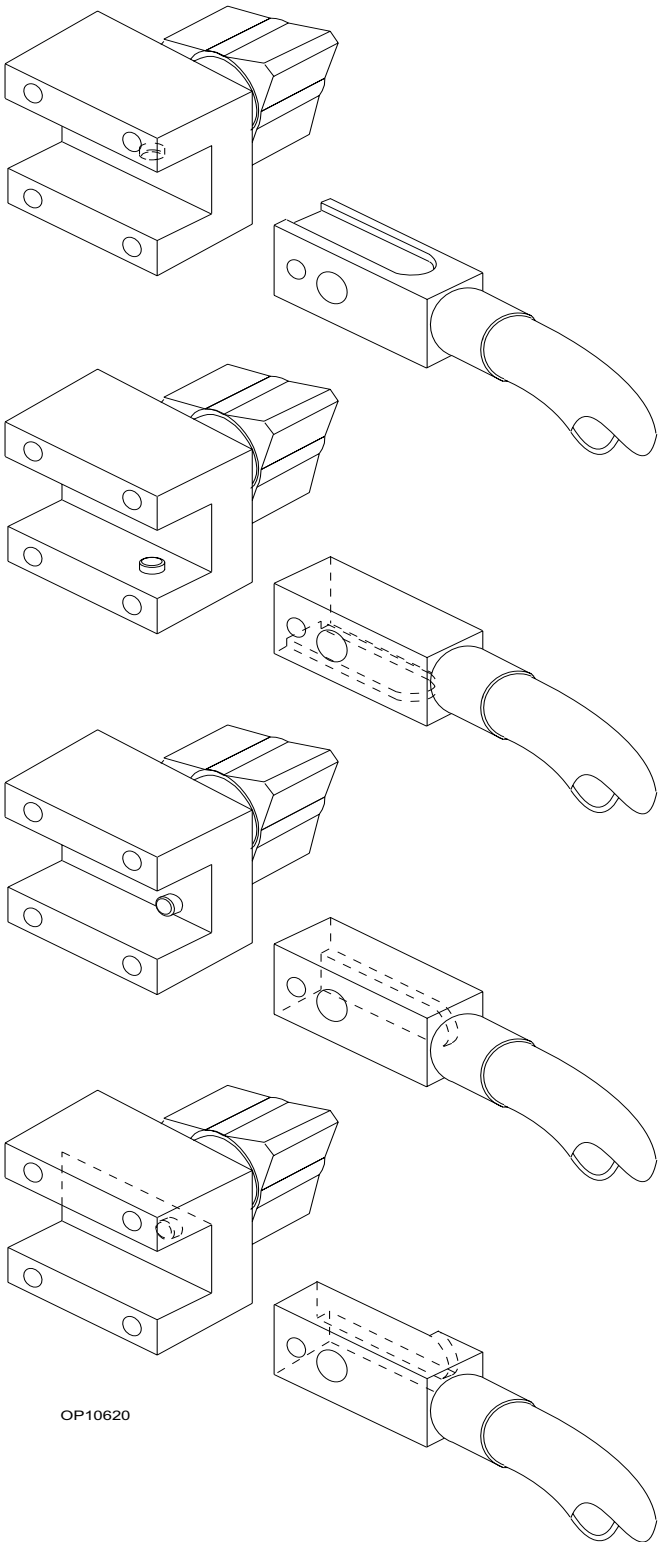
    If the vaporizer is inadvertently overfilled (FULL mark exceeded), drain the excess anesthetic. For information on draining the vaporizer, refer to “Draining Vaporizer with Key Indexed Safety System” later in this section.

14. Remove the adapter from the bottle.

15. Place the cap back on the bottle.


OP10621A
FILLER VALVE KNOB
FILLER PORT LOCK SCREW
KEYED FILLER PORT
FILLER PORT PLUG
KEYED BOTTLE ADAPTER
SIGHT GLASS
OVERFLOW LINE
FULL LINE
REFILL LINE
DRAIN VALVE KNOB
DRAIN PORT LOCK SCREW
KEYED DRAIN PORT
KEYED BOTTLE ADAPTER

Section 5 - Operation
Vaporizer



Draining the Vaporizer

Before draining a vaporizer, identify the filling system on the device as one of the following:

- Open funnel system
- Key indexed safety system

When you have identified the filling system, locate the appropriate procedure and read it entirely before draining the device.

WARNING: Do not inhale anesthetic vapors while draining the vaporizer. Uncontrolled inhalation of anesthetic vapors is injurious to health.

Draining Vaporizer With Open Funnel Spout

1. With the vaporizer in an upright position, turn the handwheel to “0” (zero-point interlock) and make sure the button engages in the locked position.
2. Place an empty anesthetic-specific bottle under the drain hole of the filling spout. Mark the bottle to indicate that it contains a previously used anesthetic agent.

WARNING: The vaporizer handwheel must be set to “0” (zero-point interlock) before the vaporizer can be drained.

3. Open the drain valve by turning it counterclockwise about three turns. Do not unscrew the valve completely.
4. Close the drain valve.

WARNING: Do not re-use drained agent.

5. Place the cap back on the bottle and dispose of the bottle in accordance with approved hospital procedures.

Section 5 - Operation
Vaporizer

Draining Vaporizer With Key Indexed Safety System

The key indexed safety system employs a matching pin-and-socket assembly to prevent inadvertent use of the wrong agent in a Vapor 19.1 device. To drain a vaporizer with key indexed safety system valves, you must have the appropriate keyed bottle adapter for the anesthetic agent.

1. With the vaporizer in an upright position, turn the handwheel to “0” (zero-point interlock) and make sure the button engages in the locked position.

2. Attach the keyed bottle adapter to the appropriate empty bottle. Tighten to assure airtight seal. Mark the bottle to indicate that it contains a previously used anesthetic.

3. Insert the bottle adapter fitting into the drain port of the vaporizer. The two holes in the adapter fitting must face the Teflon seal surface in the drain port.

4. Turn drain port lock screw clockwise to hold the adapter against the Teflon seal.

WARNING: The vaporizer handwheel must be set to “0” (zero-point interlock) before the vaporizer can be drained.

5. Hold the bottle below drain port level, and avoid kinking the plastic tube. Open the drain valve by rotating the knob counterclockwise. Allow the liquid to drain into the bottle until the vaporizer is empty. The vaporizer is empty when no anesthetic flows from the drain.

6. Close the drain valve and remove the adapter from the drain port.

WARNING: Do not re-use drained agent.

7. Place the cap back on the bottle and dispose of the bottle in accordance with approved hospital procedures.

Section 5 - Operation
Absorber System

REFER TO SEPARATE MANUAL

RETURN TO CD-ROM TABLE OF CONTENTS

Section 5 - Operation
Bain Circuit Adapter

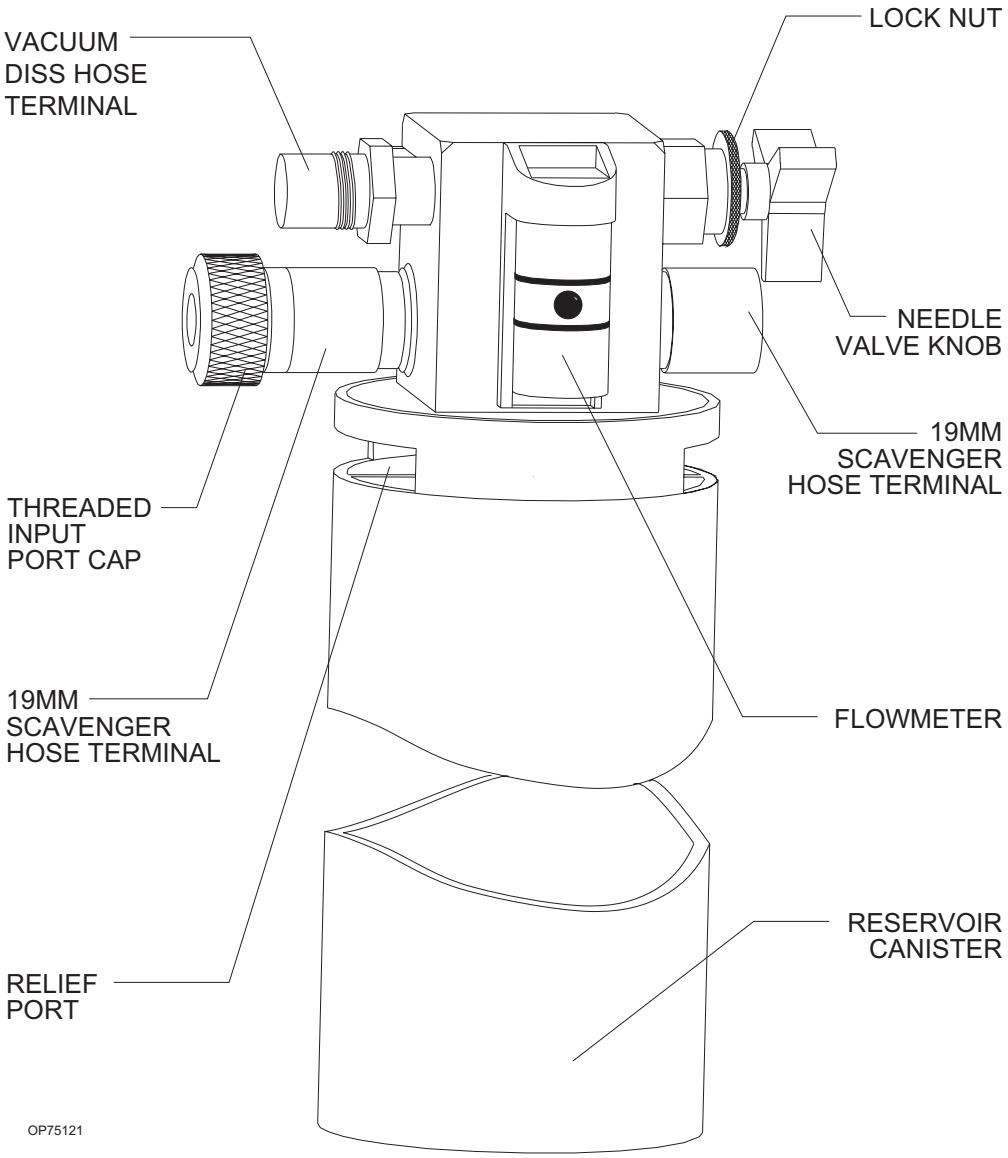
REFER TO SEPARATE MANUAL

RETURN TO CD-ROM TABLE OF CONTENTS

Section 5 - Operation
Open Reservoir Scavenger

Overview

The open reservoir scavenger is intended for use with suction (vacuum) waste gas disposal systems. This scavenging approach applies a continuous suction to transfer waste gas from the scavenger to the disposal system. The open reservoir scavenger is an “open” system, which uses continually open relief ports to provide positive and negative pressure relief.



Section 5 - Operation
Open Reservoir Scavenger

Connecting the Open Reservoir Scavenger System

The open reservoir scavenger system is installed on the Narkomed 2B before shipping. The only thing you need to do before operating the scavenger is to make the hose connections.

CAUTION: Take special care not to accidentally force 19 mm scavenger hoses over 22 mm breathing hose terminals. Carefully follow the hose connection instructions for installing the scavenger and the absorber.

To connect the scavenger hoses:

1. Attach a 19 mm scavenger hose between the 19 mm terminal (marked SCAVENGER HOSE) on the bottom of the absorber pole and the 19 mm terminal (marked SCAVENGER HOSE) on the right side of the scavenger.

WARNING: Make sure the 19 mm scavenger hoses leading from the absorber are not pinched, kinked, or blocked in any manner.

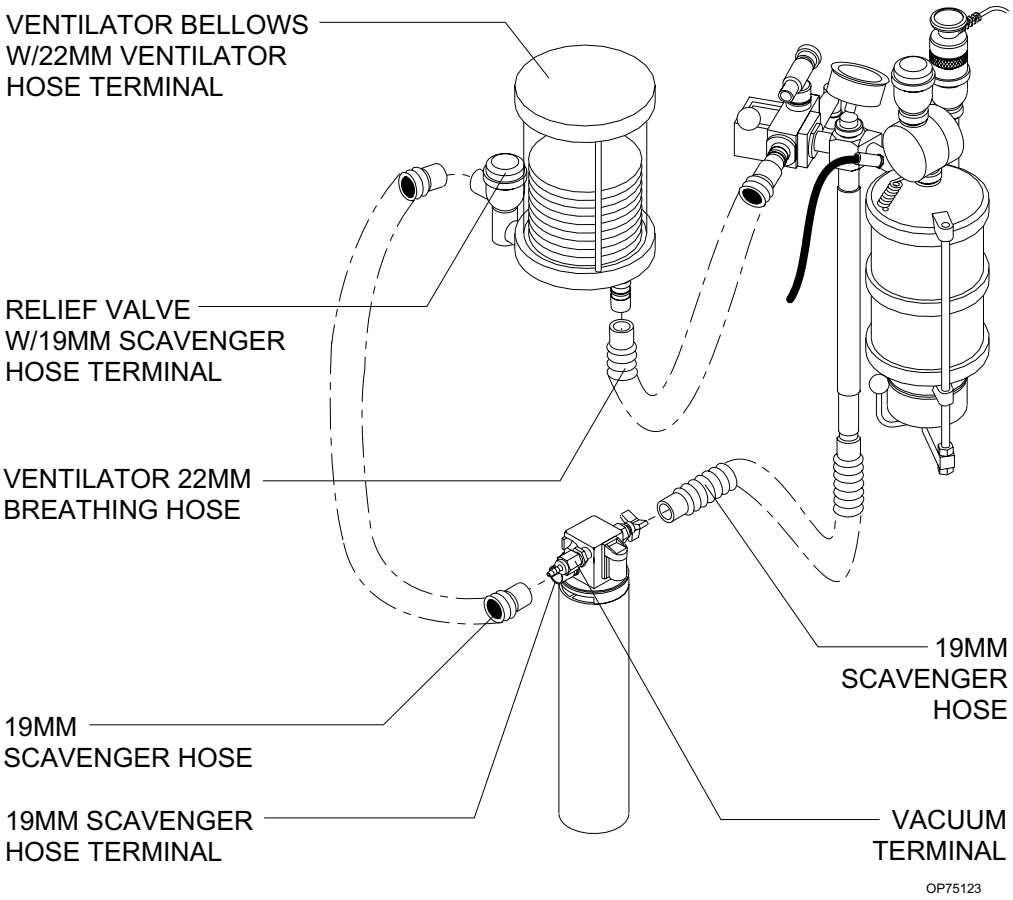
2. Attach the short 19 mm scavenger hose between the 19 mm terminal (marked SCAVENGER HOSE) on the rear of the APL valve and the 19 mm terminal (marked SCAVENGER HOSE) on the rear of the absorber pole.

3. Attach another 19 mm scavenger hose between the 19 mm terminal (marked SCAVENGER HOSE) on the ventilator relief valve and the 19 mm terminal (marked SCAVENGER HOSE) on the left-hand side of the scavenger.

WARNING: Make sure the 19 mm scavenger hose leading from the ventilator relief valve is not pinched, kinked, or blocked in any manner.

4. Attach a wall suction hose between the wall suction outlet and the suction terminal (DISS or hose barb with adapter) on the scavenger.

5. Verify the proper functioning of the scavenger system.



Operating the Open Reservoir Scavenger System

Because the open reservoir scavenger's reservoir canister is open to the atmosphere, it does not require spring-loaded relief valves. If the waste gas flow rate from the patient breathing system exceeds the disposal system's suction flow rate, the canister initially accommodates excess waste gas. After excess waste gas fills the canister, waste gas then exits through the relief ports around the top of the canister. Thus, positive pressure does not build up within the patient breathing system.

CAUTION: Waste gas vented from the relief ports may contaminate the operating room. To prevent such contamination, be sure to adjust the needle valve properly.

If the disposal system's flow rate (suction) exceeds the waste gas flow rate from the patient breathing system, the disposal system draws room air through the relief ports. Thus, the disposal system does not apply a negative pressure to the patient breathing system.

Section 5 - Operation
Open Reservoir Scavenger

Adjusting the Needle Valve

You must properly adjust the waste gas flow rate to prevent waste gas contamination of the operating room. The needle valve wing nut regulates the waste gas exhaust flow.

To adjust the needle valve:

1. Attach all appropriate hoses and verify that the waste gas disposal system is active.

2. Turn the needle valve wing nut until the flowmeter indicates a flow halfway between the two white lines etched on the scavenger's flowmeter. This setting corresponds to a suction flow rate of about 25 l/min.

Depending on the fresh gas flow rate, the needle valve setting may have to be increased or decreased to settings either above or below the lines on the flowmeter. If the suction flow rate is set too low, waste gas will exit the canister through the relief ports around the top of the canister and contaminate the operating room. If the suction flow rate is too high, the waste gas disposal system's suction capacity will be needlessly depleted and the system will be noisy.

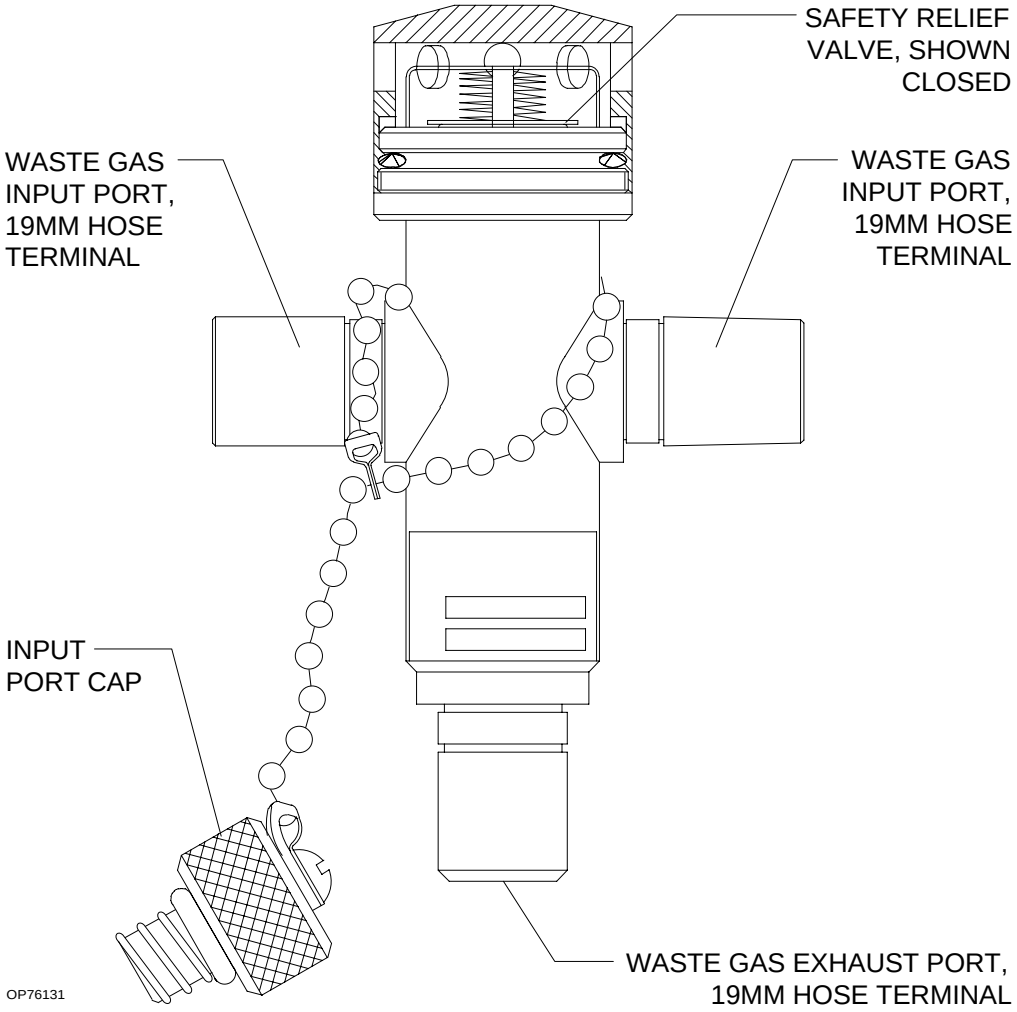
You may have to readjust the needle valve setting during a case. For example, a shared suction disposal system may provide a varying suction flow rate, depending on the number of users at any given time.

Section 5 - Operation
Scavenger Interface for Passive Systems

Overview

The Scavenger Interface for Passive Systems is intended for use with nonrecirculating HVAC systems (also called exhaust systems). This scavenging approach relies on the pressure of the waste gas itself to transfer the gas from the scavenger to the disposal system. The scavenger interface is a “closed” system, which uses a spring-loaded valve for positive pressure relief.

WARNING: Do not use this device with a waste gas disposal system capable of applying a negative pressure to the scavenger interface (a suction or vacuum waste gas disposal system).

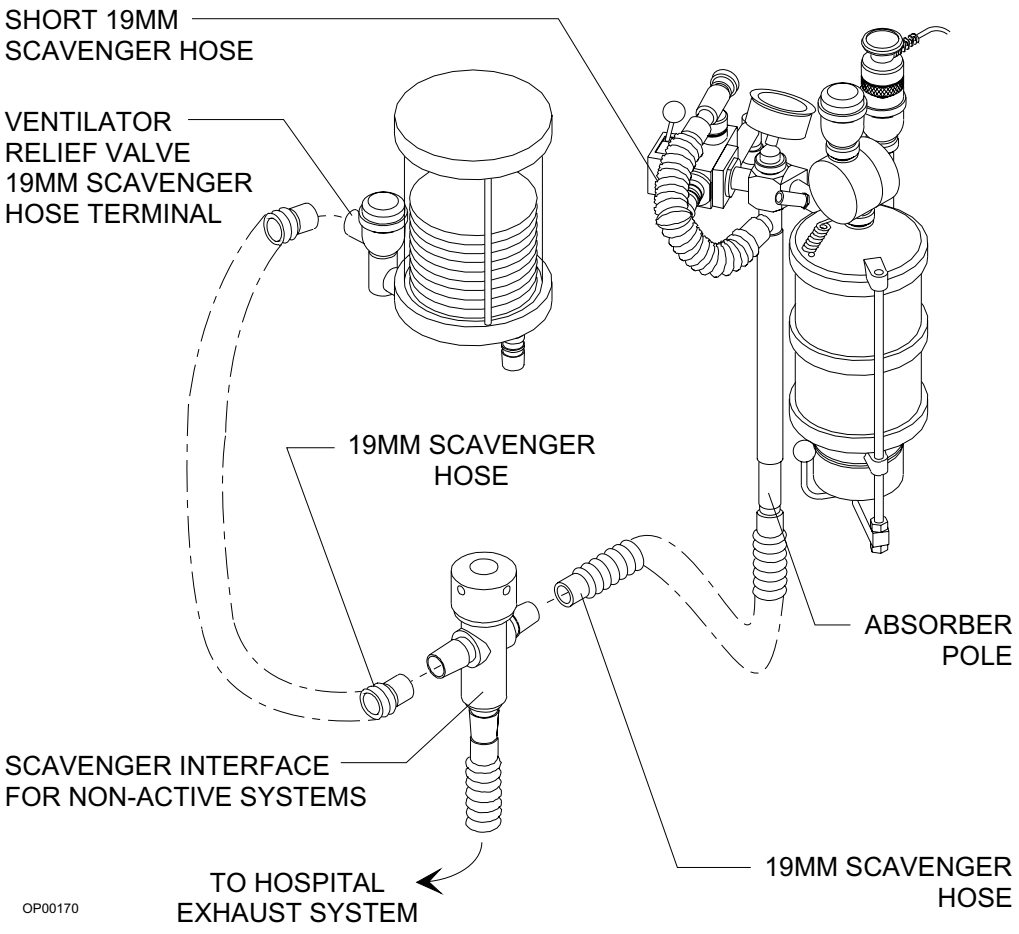

SAFETY RELIEF VALVE, SHOWN CLOSED
WASTE GAS INPUT PORT, 19MM HOSE TERMINAL
WASTE GAS INPUT PORT, 19MM HOSE TERMINAL
INPUT PORT CAP
WASTE GAS EXHAUST PORT, 19MM HOSE TERMINAL
OP76131

Section 5 - Operation
Scavenger Interface for Passive Systems

Operating the Scavenger Interface for Non-active Systems

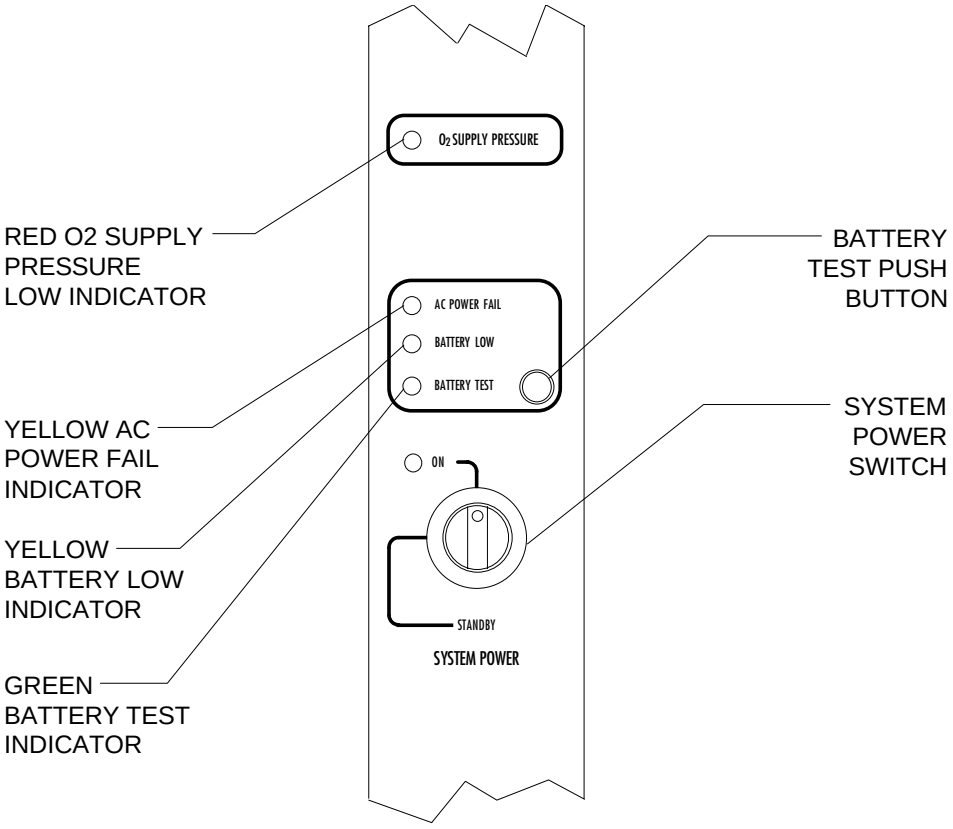
In a typical anesthesia circle system, waste gas exits form the breathing system APL or ventilator relief valves and passes through the scavenger to the exhaust system. If the hospital exhaust system stopped functioning (or if the path between the scavenger and the exhaust system becomes blocked), positive pressure would build up within the scavenging and breathing systems. To prevent such a harmful pressure build-up, the scavenger's positive pressure relief valve is set to open at a pressure of 5 cm H_2O. Waste gas then exits through the holes in the relief valve housing. Therefore, you do not have to adjust this scavenger. You must, however, make sure that hoses are properly connected and that the positive pressure safety relief valve is functioning.

WARNING: The positive pressure relief valve must be inspected and cleaned (if necessary) at six month intervals.



Overview

The main switch panel, located between the ventilator bellows and flowmeter bank, incorporates the SYSTEM POWER switch and indicator lights for low O_2 supply pressure, AC power failure, and battery low alarms. These alarms are annunciated and displayed on the central alarm display.



System Power Switch

The SYSTEM POWER switch on the Narkomed 2B has two positions: ON and STANDBY. In the ON position the gas (pneumatic) and electric power circuits are activated and the green LED indicator adjacent to the switch is illuminated. In the STANDBY position the gas supplies, the monitoring system, and all electrical power to the machine except the convenience receptacles and battery charging circuit are deactivated.

NOTE: The battery charging circuit and convenience receptacles are active whenever the power cable is attached to an active wall receptacle, regardless of the switch setting.

Testing the Battery

The backup battery system shall be tested daily. To test the battery:

1. Turn the SYSTEM POWER switch ON, and wait until the power-on diagnostic screen is no longer displayed.
2. Remove the machine's power plug from the electrical outlet.
3. Press and hold the BATTERY TEST button.
4. If the battery is sufficiently charged, the green BATTERY TEST light illuminates after a short delay.

Usually, a fully charged battery can power the electrical components of the anesthesia machine for at least 30 minutes in the event of a power failure.

NOTE: During an AC power loss, the BATTERY LOW indicator is illuminated when the battery reserve approaches depletion. However, do not rely solely on this indicator for an assessment of battery capacity. If the backup battery becomes completely depleted and the machine does not have AC power, the BATTERY LOW indicator light has no source of power and does not function. Therefore, always remember to perform the pre-use battery test.

To prevent premature battery failure, use backup battery power only during interruption of primary AC power. Do not start an anesthetic procedure on the anesthesia machine if the AC POWER FAIL indicator light or the BATTERY LOW indicator light is illuminated.

Overview

The AV2+ anesthesia ventilator is a volume preset, time cycled, pressure limited ventilator with electronic timing, pneumatic circuitry and independent controls for frequency, inspiratory to expiratory (I:E) ratio, inspiratory flow rate, tidal volume, and inspiratory pressure limit.

Pneumatic power (bellows drive gas) to the ventilator is supplied through the hospital pipeline supply or through reserve cylinders on the anesthesia machine. The pressure of the supply gas must be between 40 and 60 psi. The ventilator will not function if this pressure drops below 32 psi. Electrical power is supplied by the Narkomed 2B's AC power source, or, in event of AC power failure, by the backup battery. A fully charged battery can power the ventilator for approximately 30 minutes.

The anesthesia ventilator is designed for use with a North American Dräger absorber system, which incorporates a manual/automatic selector valve. This valve allows you to select either the breathing bag and adjustable pressure limiter (APL) valve for manual ventilation, or the ventilator bellows for automatic ventilation.

During automatic ventilation, the manual/automatic selector valve isolates the absorber's APL valve from the breathing system. To compensate for the continuous introduction of fresh gas into the breathing system, the ventilator incorporates a relief valve mounted behind the bellows chamber.

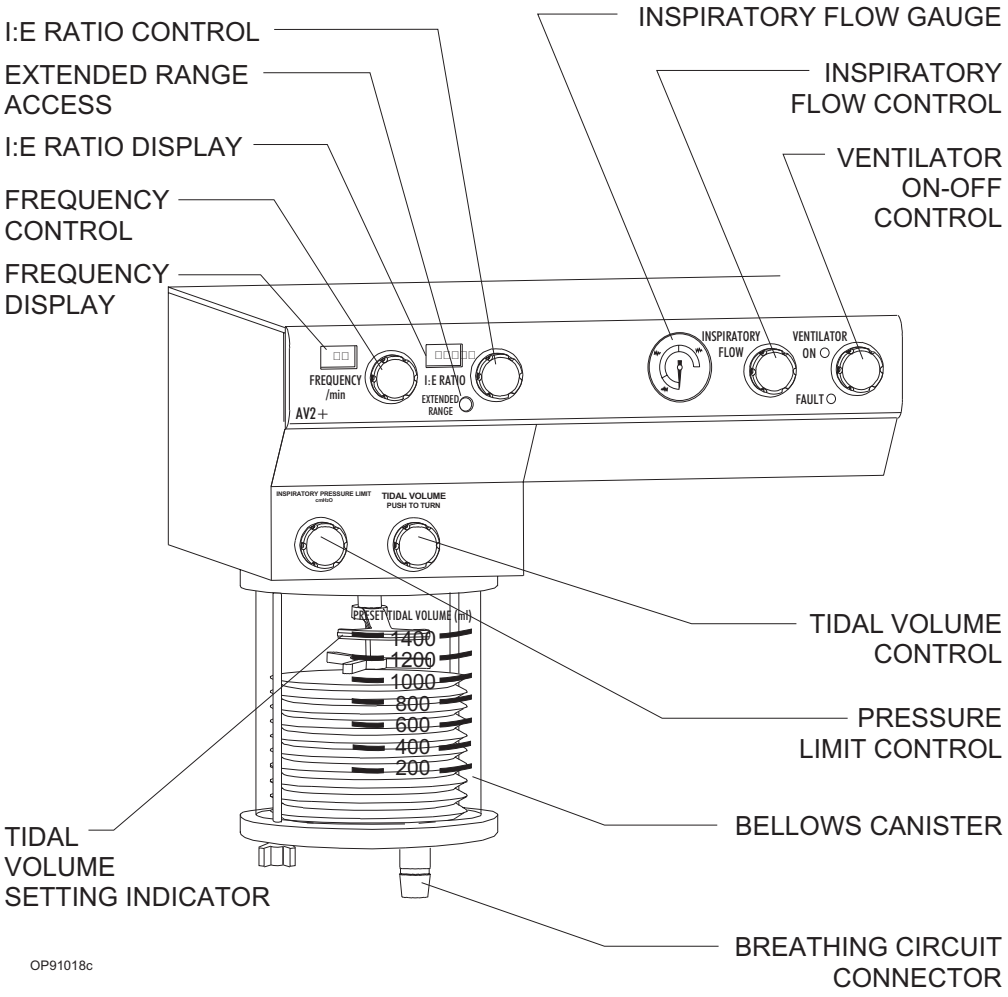
When the bellows is completely filled, any excess gas in the system is released to the scavenging system through the ventilator relief valve. As in any ascending bellows, the force needed to overcome gravity acting on the bellows causes a positive end-expiratory pressure (PEEP) within the breathing system. For the Narkomed 2B, the PEEP is approximately 2 cmH_2O.

The monitoring system's breathing pressure and expiratory flow waveform displays can be used as an aid in adjusting the ventilator and establishing alarm criteria.

WARNING: Regardless of the indications of any alarm or monitoring device, patient chest movement shall be the primary indication of a securely connected, properly ventilated patient.

A front view of the AV2+ anesthesia ventilator is shown in the following figure.

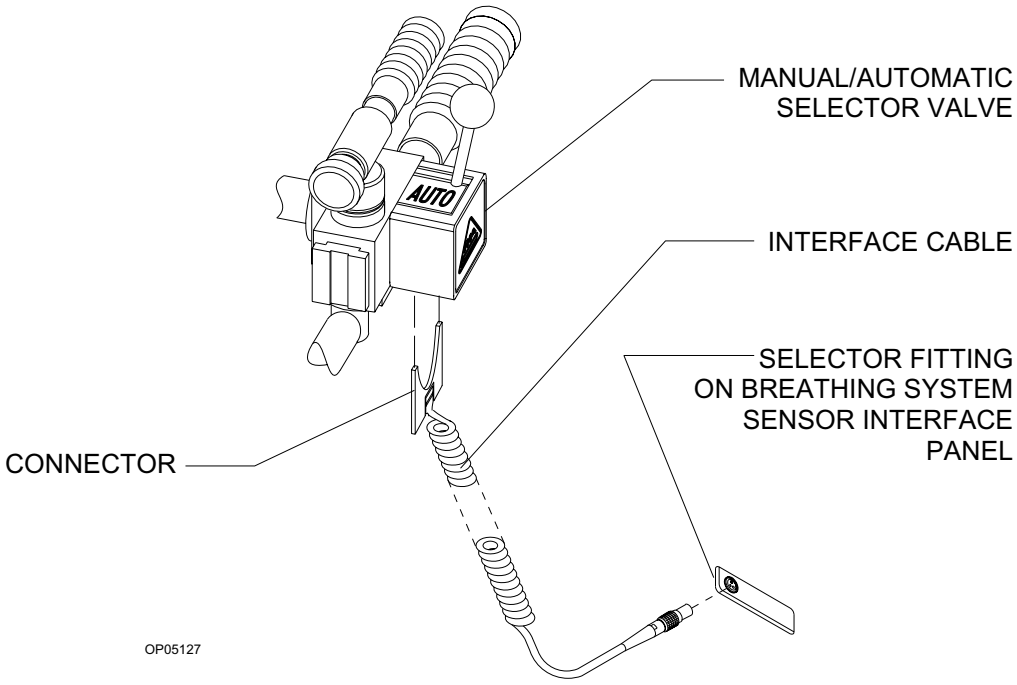
Section 5 - Operation
AV2+ Anesthesia Ventilator



Activating the Ventilator

The ventilator can be activated by using the ventilator on/off control, or, optionally, by using the lever on the manual/automatic selector valve. The anesthesia machine's SYSTEM POWER switch must be set to ON in order for the ventilator to function.

NOTE: The selector valve lever can activate the ventilator only when the interface cable is connected between the manual/automatic selector valve and the SELECTOR fitting on the breathing system sensor interface panel (see following illustration); when the interface cable is disconnected, the position of the selector lever has no effect on the ventilator.



When the ventilator is activated, both pneumatic and electric power to the ventilator are turned on, and the monitoring system's volume and pressure alarms are automatically enabled. When the ventilator is turned off, the FREQUENCY and I:E RATIO displays remain lighted, but the ventilator will not function.

Using the Ventilator On/Off Control

The ventilator on/off control is a momentary switch that returns to its center position after being turned in either direction.

- To activate the ventilator, turn the switch clockwise; the green ON indicator is then turned on and the switch returns to its center position.

  NOTE: The ventilator can only be activated when the manual/automatic selector valve is in the AUTO position (with the interface cable between the selector valve and interface panel connected). If you attempt to activate the ventilator with the selector lever in the BAG position, the yellow FAULT indicator on the ventilator bezel will be turned on, indicating a fault condition.

- To shut down the ventilator, turn the switch counterclockwise; the green ON indicator is then turned off and the switch returns to its center position.

Using the Manual/Automatic Selector Valve Lever

The ventilator can be turned on and off with the selector lever on the manual/automatic selector valve (with the interface cable between the selector valve and interface panel properly connected).

NOTE: When you operate the lever, let it snap into position. Do not hold back on the lever; preventing its free movement could damage the ventilator's sensors.

- To activate the ventilator, move the manual/automatic selector valve lever to the AUTO position; the green ON indicator on the ventilator bezel is then turned on.

- To shut down the ventilator, move the manual/automatic selector valve lever to the BAG position; the green ON indicator on the ventilator bezel is then turned off.

Adjusting the Tidal Volume

The tidal volume is adjusted using a self-locking knob, located above the bellows assembly. The control knob positions a stop within the bellows canister which limits the upward travel of the bellows and thus sets the maximum tidal volume of gas delivered to the patient. To adjust the tidal volume, press the self-locking knob so that it can turn, then set the desired tidal volume as shown by the setting indicator on the bellows chamber scale (marked 200–1400 ml). The tidal volume can be adjusted to achieve volumes between 50 and 1500 ml.

Smaller tidal volumes can be adjusted by setting the pointer below the 200 ml marking on the bellows chamber; larger tidal volumes can be selected by setting the pointer above the 1400 ml calibration.

As in any volume-preset anesthesia ventilator, the actual tidal volume delivered to the patient's lungs may differ from the preset volume at the bellows due to the compliance of the breathing system and fresh gas flow. To accurately set the tidal volume, refer to the tidal and minute volume measurements.

The position of the tidal volume indicator can be calibrated for a specific combination of fresh gas flow and equipment compliance by a North American Dräger qualified technical service representative.

Setting the Respiratory Frequency

Use the frequency control knob to set the respiratory frequency from 1 to 99 breaths per minute (BPM) in 1 BPM increments.

Clockwise rotation of the control knob increases the frequency setting, while counterclockwise rotation decreases the frequency setting.

Setting the Inspiratory/ Expiratory (I:E) Phase Time Ratio

Use the I:E ratio control knob to set the inspiratory/expiratory (I:E) phase time ratio. The standard range of ratios is from 1:1 through 1:4.5, adjustable in increments of 0.5.

An extended range of ratios is also available which allows the setting of inverse I:E ratios. The specific extended range settings are: 4:1, 3:1, and 2:1. The extended range settings are accessible by pressing the EXTENDED RANGE switch while rotating the I:E ratio control knob.

Clockwise rotation of the control knob increases the I:E ratio setting, while counterclockwise rotation decreases the I:E ratio setting.

WARNING: The use of inverse I:E ratios will introduce auto-PEEP.

Setting the Inspiratory Flow Rate

Use the inspiratory flow control knob to set the inspiratory flow in the range of 10 l/min to 100 l/min. This setting controls the flow rate of gas into the bellows canister, and thus the flow rate of gas delivered to the patient.

Because of patient circuit variables such as lung compliance, fresh gas flow, airway resistance and equipment compliance, the flow gauge is labeled with nominal zones of LOW, MEDIUM, and HIGH.

You should adjust the flow setting to a point where the ventilator bellows is fully compressed (but not deformed) at the end of the inspiratory phase of the breathing cycle.

You can also use the inspiratory flow control to create an inspiratory plateau at the end of the inspiratory cycle and to affect the potential peak inspiratory pressure within the patient breathing system. Always check the pressure indicated by the breathing system pressure gauge and waveform when adjusting the inspiratory flow control.

Setting the Inspiratory Pressure Limit

The pressure limit control, located above the bellows canister, is used to adjust the pressure limit. Nominal pressure zones are indicated by the label. This control determines the maximum pressure that can be delivered by the ventilator during the inspiratory phase of the respiratory cycle. Because of patient circuit variables, the scale on the label is only a reference; the pressure should be read from the breathing system pressure gauge or the anesthesia machine's pressure monitoring system.

When the pressure limit control is turned fully counterclockwise, the peak inspiratory pressure will be less than or equal to 15 cmH_2O. When the control is turned fully clockwise, the peak inspiratory pressure will be less than or equal to 120 cmH_2O.

Problem Resolution

PROBLEM	POSSIBLE CAUSE	REMEDY
Excessive PEEP	Improperly adjusted ventilator relief valve	Contact NAD qualified technical service representative.
	Insufficient suction scavenger flow setting	Increase suction scavenger flow valve.
	PEEP valve active	Decrease PEEP valve setting.
	Inverse I:E ratios	Reset ratios.
Excessive NEEP	Excessive suction scavenger flow	Reduce suction scavenger flow rate.
Bellows won't reach tidal volume stop setting during expiration	Frequency too high for selected tidal volume	Decrease frequency.
		Increase expiratory phase time.
	Improperly adjusted ventilator relief valve	Contact NAD qualified technical service representative.
	Breathing system leak	Repair leak.
Ventilator won't cycle	Low oxygen supply pressure	Provide sufficient oxygen supply pressure.
Moving manual/ automatic selector valve lever to AUTO position does not activate ventilator.	SYSTEM POWER switch is in STANDBY position	Turn SYSTEM POWER switch to ON.
	Interface cable is not connected	Connect interface cable.

PROBLEM	POSSIBLE CAUSE	REMEDY
Ventilator does not operate; yellow FAULT LED on ventilator lights	Selector switch on the absorber is in the BAG position	Turn the selector switch on the absorber to the AUTO position.
Bellows won't compress during inspiration	Absorber manual/ automatic selector valve in BAG position	Place selector valve in AUTO position.
	Inspiratory flow control setting on ventilator too low	Increase inspiratory flow control setting.
	Frequency too high	Decrease frequency.
	Inspiratory pressure limit setting on ventilator too low	Increase inspiratory pressure limit setting.

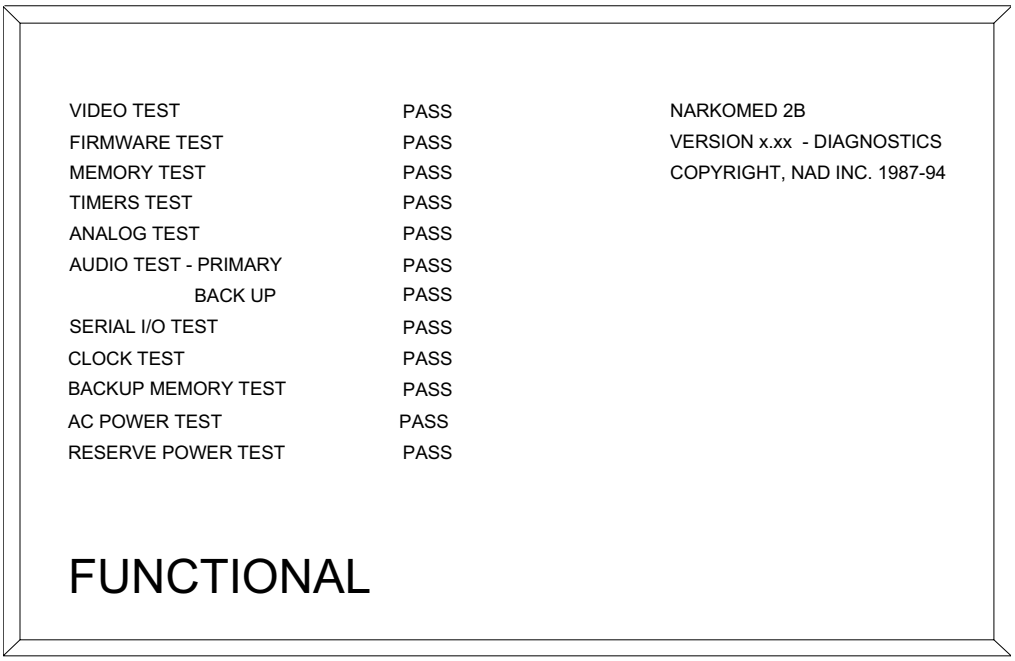
RETURN TO CD-ROM TABLE OF CONTENTS

Overview

In addition to monitoring clinical parameters, the Narkomed 2B performs diagnostic self-tests every time the machine is turned on. After the initial power-on screen is displayed, the monitor screens are displayed. This section of the manual describes the power-on screen and explains how to work with the monitoring screens and their controls.

Power-On Screen

When you turn the SYSTEM POWER switch to the ON position, the Narkomed 2B performs extensive self-tests on its internal hardware. As these diagnostics are performed, each test and its result (PASS or FAIL) appear on the left-hand display screen, indicating the status of various components of the monitoring system.



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At the end of the self-diagnostics, one of three possible conclusions to the self-tests is posted on the left-hand screen:

FUNCTIONAL	Every component of the monitoring system is in satisfactory operational order. Normal operation of the machine continues.
CONDITIONALLY FUNCTIONAL	A noncritical fault was detected, such as a speaker failure. You can use the Narkomed 2B, but first note the test that failed. Report the problem to a North American Dräger qualified technical service representative when convenient.

When you are ready to resume operation, press the key indicated on the left-hand screen.

NONFUNCTIONAL — A serious fault was detected. The monitoring system will not operate under this condition. Do not use the machine. Immediately notify a North American Dräger qualified technical service representative to correct the problem.

Monitor Screens and Controls

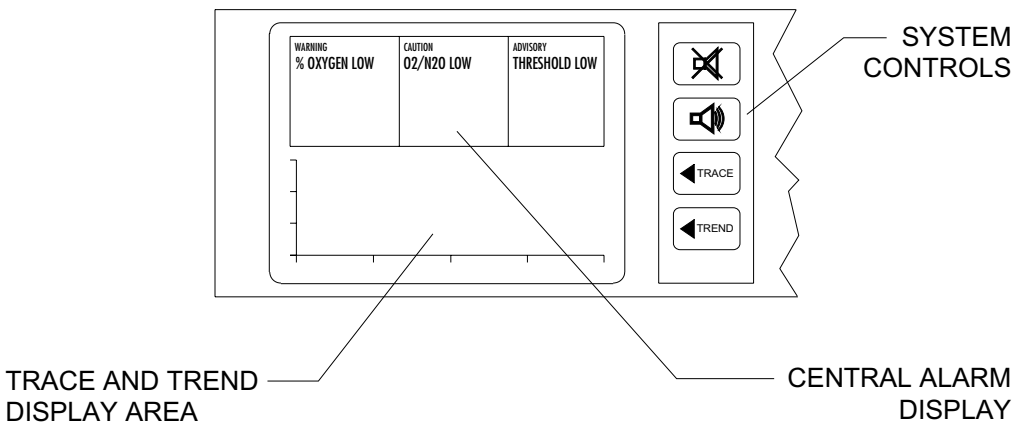
Following a successful power-up, monitoring information is displayed on the anesthesia machine's screens. The keys to the right of each screen allow you to control the displays and other monitor functions.

Left-Hand Screen

The top half of the left-hand screen displays alarm messages. (These alarms were discussed in detail in Chapter 2.) On the bottom half of the screen, you can display graphical trace or trend data. You can also use this area of the screen to configure the anesthesia machine.

The four keys to the right of the screen control the audio annunciation of alarms and the type of data displayed on the screen. These keys are discussed in this section.

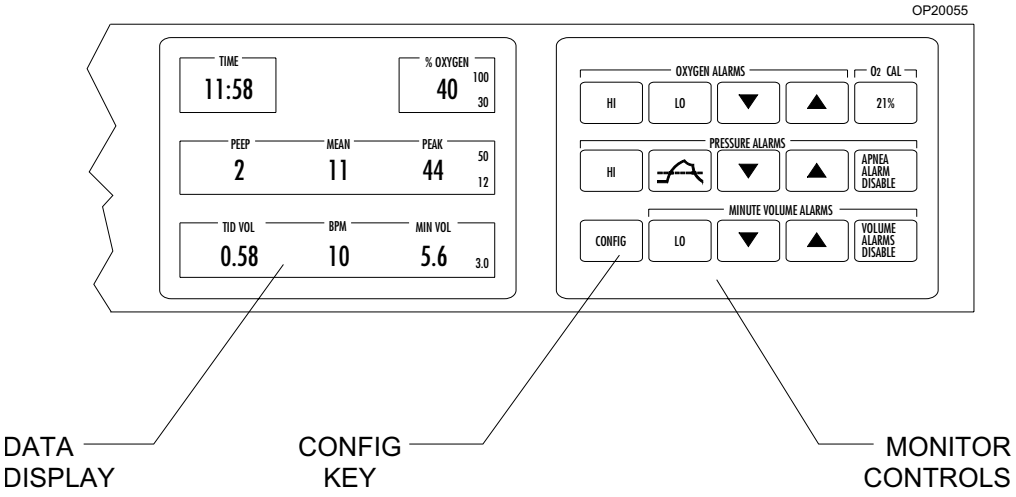
OP20015



Right-Hand Screen

The right-hand screen displays the time, as well as numerical measurements for oxygen concentration, breathing pressure, and respiratory volume. The most current measurements are always displayed on this screen, as long as the associated monitor is supplying information.

The keys to the right of the display area allow you to configure the anesthesia machine, calibrate the oxygen sensor, set alarm limits, and turn the apnea and volume alarms on and off. Configuration of the machine and control of audible alarms are explained in this section. The remaining monitor control functions are described in the following sections: “Oxygen Monitoring,” “Respiratory Volume Monitoring,” and “Breathing Pressure Monitoring.”



Configuring the Anesthesia Machine

You can configure the following parameters on the Narkomed 2B:

– audio annunciator volume
– current date
– current time
– serial Port A parameters

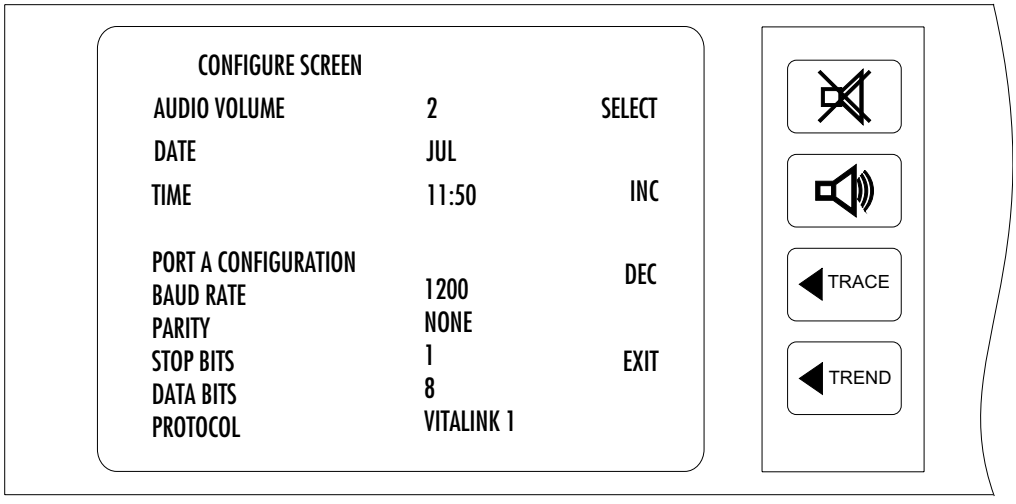
NOTE: You can configure Port A only. It communicates using the Vitalink Communications Protocol. (Refer to the *Vitalink Technical Reference Manual* for Vitalink programming details.) You cannot configure Port B. It is permanently configured for use with the Co•Writer anesthesia recorder.

When you start the anesthesia machine, it uses the values that were established the last time the machine was configured. You can view or change these values on the Configure screen.

Displaying the Configure Screen

To display the Configure screen, press the CONFIG key. The CONFIG key is located in the bottom row of keys to the right of the right-hand display screen. (See the figure on the previous page.)

The Configure screen replaces the standard left-hand screen display of alarms, trends, and waveforms. You must begin configuration within one minute, or the standard screen will replace the Configure screen.



OP20020

Understanding the Configuration Keys

When the Configure screen is displayed, the control keys function according to the labels on the screen.

Key	Label	Configuration Function
	SELECT	Selects a parameter on the Configure screen by highlighting it with a box
	INC	Increases the value of the highlighted parameter
	DEC	Decreases the value of the highlighted parameter
	EXIT	Exits the Configure screen and returns to the standard display

Changing Parameter Values

Follow this procedure for each parameter you want to change.

1. Press the SELECT key until the parameter you want to change is highlighted with a box.

2. Change the value of the highlighted parameter:

   - To increase the value, press the INC key.

   - To decrease the value, press the DEC key.

Exiting the Configure Screen

To exit the Configure screen immediately, press the EXIT key.

NOTE: The monitoring system automatically exits the Configure screen if no keys are pressed for one minute.

When you exit the Configure screen, the values displayed on the screen are saved. The monitoring system uses these values until they are changed.

Section 5 - Operation
Monitoring System

Controlling Continuous Audible Alarms

You can silence and enable the Narkomed's continuous audible alarms with the top two system control keys, located next to the left-hand screen.

NOTE: You can set alarm limits and control the respiratory volume and apnea alarms with the monitor control keys. These alarm functions are discussed in the following sections: "Oxygen Monitoring," "Respiratory Volume Monitoring," and "Breathing Pressure Monitoring."

Silencing the Alarms

Use the Audible Alarm Silence key to temporarily silence continuous audible alarms:

- Press once for 60 seconds of silence.
- Press twice for 120 seconds of silence.

After you press the Audible Alarm Silence key, a message indicating the silence condition and the silence time remaining is displayed in the Advisory section of the central alarm display. If a new alarm occurs during the Audio Silence period, a single tone pattern sounds corresponding to the priority of the alarm. After the Audio Silence period, audio annunciation reverts to normal operation if no alarms are active at that time.

NOTE: All continuous audible alarms are automatically silenced for 120 seconds following power-up. During this period, the occurrence of a new alarm will produce a non-repeating tone pattern appropriate for that alarm's level of urgency.

Enabling the Alarms

To enable continuous audible alarms that have been silenced, press the Alarm Enable key.

The audible alarms are immediately enabled.

Working with Trace Data

The NARKOMED monitors breathing pressure. You can display the breathing pressure waveform, or trace, on the Trace and Trend display area at the bottom of the left-hand screen.

Displaying the Trace

Following power-up, the breathing pressure waveform is displayed on the left-hand screen.

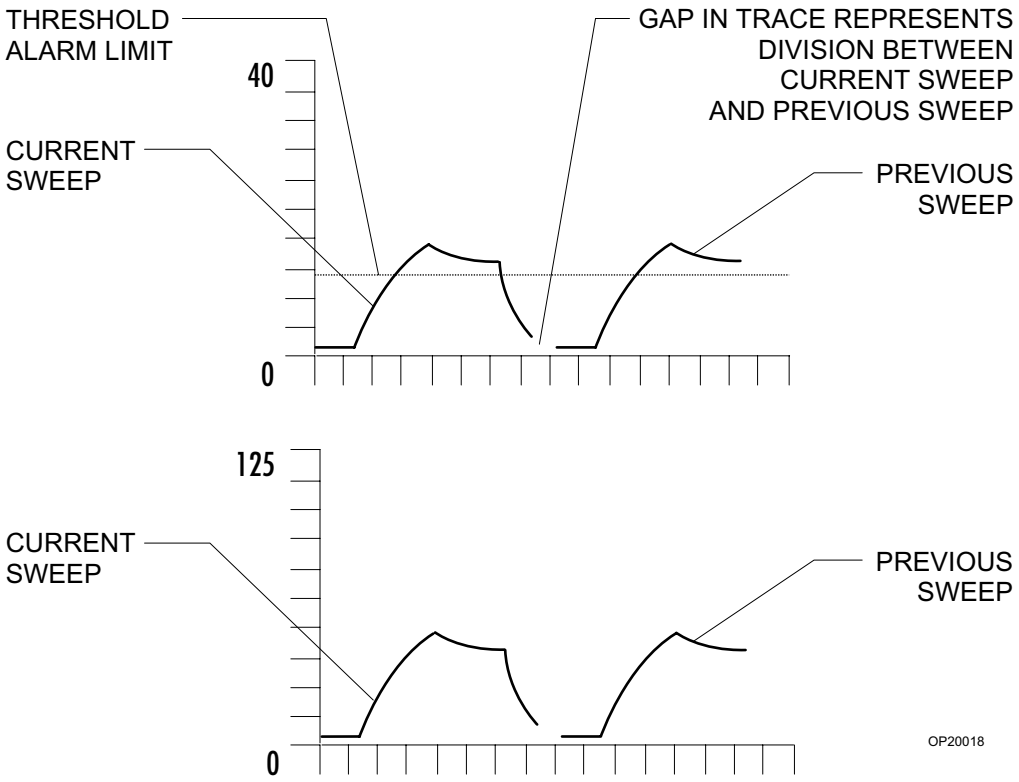
If the breathing pressure waveform is not currently displayed, you can display it by pressing the TRACE key.

Understanding the Trace Display

The breathing pressure waveform provides a visual assessment of lung mechanics and ventilation. The waveform is displayed in one of two scales, depending on the setting of the high pressure alarm limit. When the broader scale is used, the threshold pressure alarm limit appears on the display.

High Pressure Alarm Limit	Scale Used	Threshold Pressure Alarm Limit
≤60 cmH_2O	0–40 cmH_2O	displayed as a horizontal dotted line
>60 cmH_2O	0–125 cmH_2O	not displayed

A sample trace display is shown in the following figure. For more information about the trace display, see the “Breathing Pressure Monitoring” section.



Working with Trend Data

The NARKOMED monitor records measurements for the following variables over time: percent oxygen, breathing rate, and minute volume. You can display trend, or historical, data for these variables on the Trace and Trend display area at the bottom of the left-hand screen. If compatible external monitors (i.e., pulse oximeter, NIBP, or CO_2) have been interfaced with the system, trend displays for oxygen saturation, pulse, temperature, blood pressure, and CO_2 parameters can also appear.

Displaying Trend Data

1. To display trend data, press the TREND key.

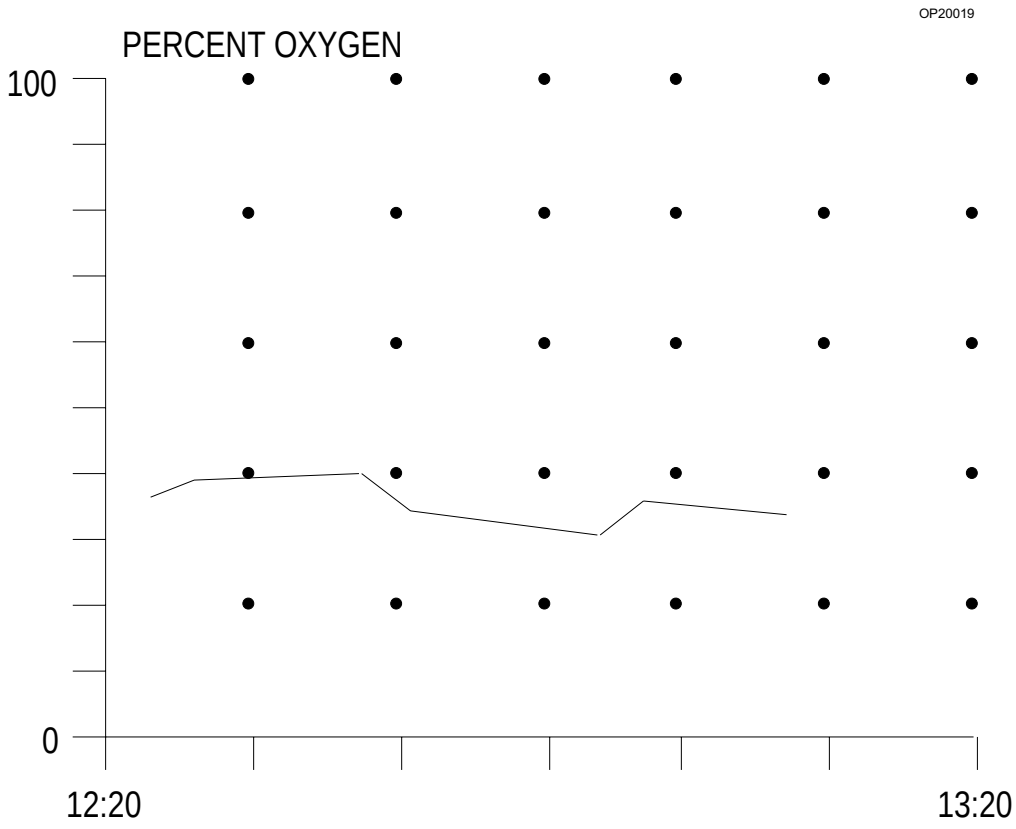
   Trend data for the first monitored variable is displayed.

2. To cycle through all of the available trend displays, continue pressing the TREND key.

   If trend data for a variable does not appear, that variable's monitor is not supplying information.

Understanding the Trend Display

The trend display is in the form of a line graph, representing the historical variations of the trended measurement. The line travels from left to right across the graph as new trend data accumulates.



The name of the selected trend variable appears above the trend graph's vertical axis (PERCENT OXYGEN, above). The scale of the vertical axis is fixed. The horizontal axis displays the most recent one-hour time period (12:20–13:20, above), divided into ten-minute increments. Time measurements are shown in 24-hour format.

Since the NARKOMED 2B starts trending available data on power-up, it rounds off the time scale labeling to the previous ten-minute increment for ease of reading. For example, if the NARKOMED 2B is powered-up and begins monitoring at 12:23, the left-most time mark will be 12:20.

NOTE: The gap preceding the start of the trend line (12:20–12:23, above) indicates that no data was recorded during that time interval.

As trending proceeds past one hour, the trend display adjusts the time scale as follows: When the graph fills up with trend data, the trend display creates a new time scale that carries over only the most recent 50 minutes of data from the previous graph. The other 10 minutes of trend data is erased from memory.

NOTE: The Noninvasive Blood Pressure (NIBP) trend appears as a vertical bar on the display screen. The top and bottom of the bar represent systolic and diastolic pressure respectively, and the unshaded gap in the bar represents the mean blood pressure.

The CO_2 trend appears as a shaded area on the screen showing the CO_2 envelope, with the top of the area representing end-tidal CO_2 and the bottom representing inspiratory CO_2.

For more information about specific trend graphs, see the following sections: “Oxygen Monitoring,” “Respiratory Volume Monitoring,” and “Breathing Pressure Monitoring.”

Working with Numerical Data

The NARKOMED displays the following numerical information from all monitors on the right-hand display screen:

- Current time
- Oxygen concentration delivered to patient (% Oxygen)
- Breathing Pressure Measurements:
  - PEEP
  - Mean
  - PEAK
- Respiratory Volume Measurements:
  - Tidal Volume (TID VOL)
  - Breathing Rate in Breaths per Minute (BPM)
  - Minute Volume (MIN VOL)

Small numbers that appear to the right of the measured variables are alarm limits. If the space reserved for a variable’s measurement is blank, that variable’s monitor is not supplying information.

Keys grouped to the right of the data display control various monitor functions. The individual monitor sections that follow explain these controls and their interaction with the data display.

Overview

Inspiratory oxygen concentration is measured with a dual galvanic cell sensor which is attached to the inspiratory valve dome. The sensor works by taking in oxygen, which initiates an electrochemical reaction within the oxygen sensor. The oxygen monitor reads the voltage produced by this reaction and translates it into an oxygen concentration measurement. The sensor incorporates two independent electrochemical cells (or sensor halves), and the oxygen monitor averages the signals produced by the cells.

CAUTION: Never remove an oxygen sensor from its housing, except to replace it. If a sensor is removed from its housing, you must do the following before continuing normal operations:

- Reinstall the sensor in the housing.
- Wait for a period equal to the time that the sensor spent outside the housing.
- Calibrate the sensor.

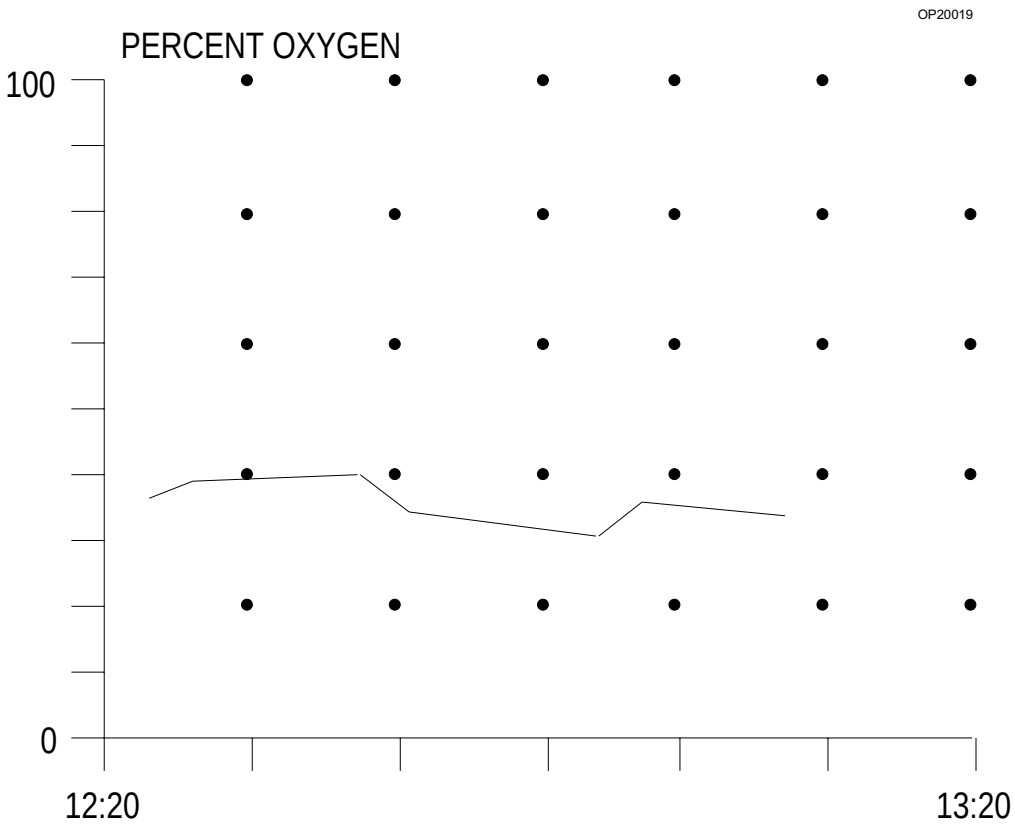
NOTE: When the machine is not in use, remove the oxygen sensor assembly from the inspiratory valve dome, and insert the inspiratory valve dome plug into the inspiratory valve dome.

Section 5 - Operation
Oxygen Monitoring

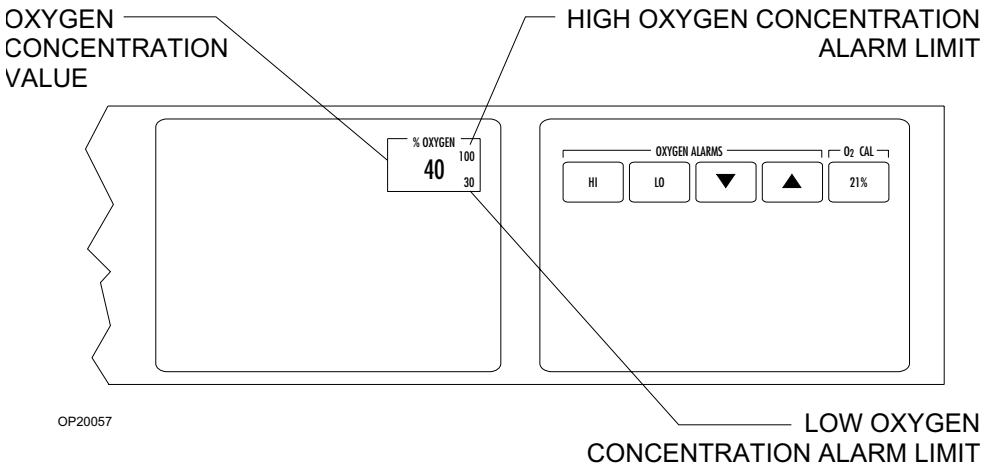
Monitor Displays

Information about the oxygen analysis is presented on the two monitor screens.

- **Left-Hand Screen**—You can display the inspiratory oxygen trend on this screen by pressing the TREND key until the PERCENT OXYGEN graph appears.

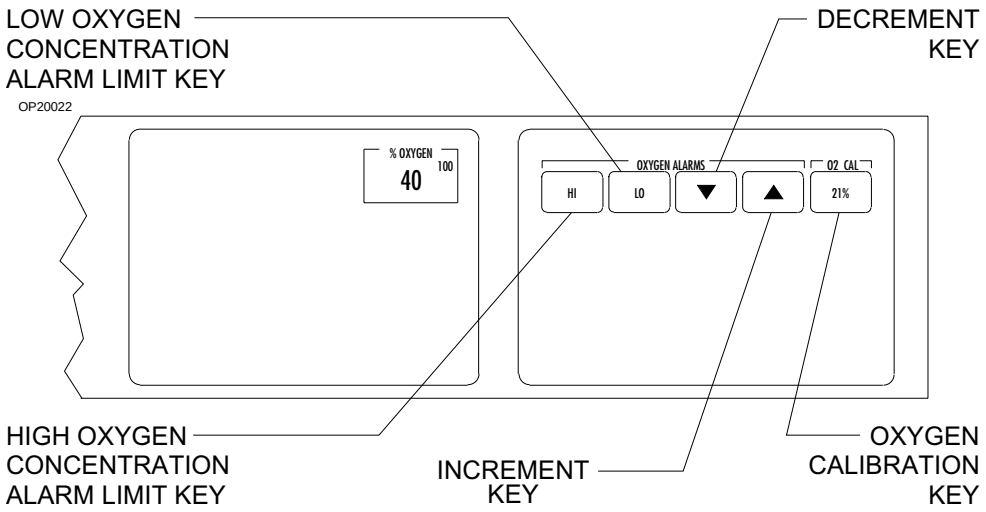


- **Right-Hand Screen**—The numerical value for inspiratory oxygen is shown on the right-hand screen. To the right of this number, in smaller type, are the high and low oxygen concentration alarm limits.



Monitor Controls

You use the oxygen monitor control keys to set oxygen concentration alarm limits and calibrate the oxygen sensor. These keys are in the top row of the key bank to the right of the right-hand display screen.



Setting Alarm Limits

The oxygen alarm limits are automatically set to the defaults at power-up. You can adjust the alarm limits within specified ranges. The valid values and the defaults are shown in the following table:

Alarm Limit	Default	Possible Values
High	100%	19%–100%; must be greater than low alarm limit
Low	30%	18%–99%; must be less than high alarm limit

Follow these steps to change the high or low alarm limit:

1. Press the HI or LO oxygen alarm key, depending on which alarm limit you want to change.

   A box is drawn around the selected alarm limit.

2. Press the increment (up arrow) or decrement (down arrow) key to increase or decrease the highlighted alarm limit.

   If you do not press a key within five seconds, the highlighting box disappears. To begin again, return to step 1.

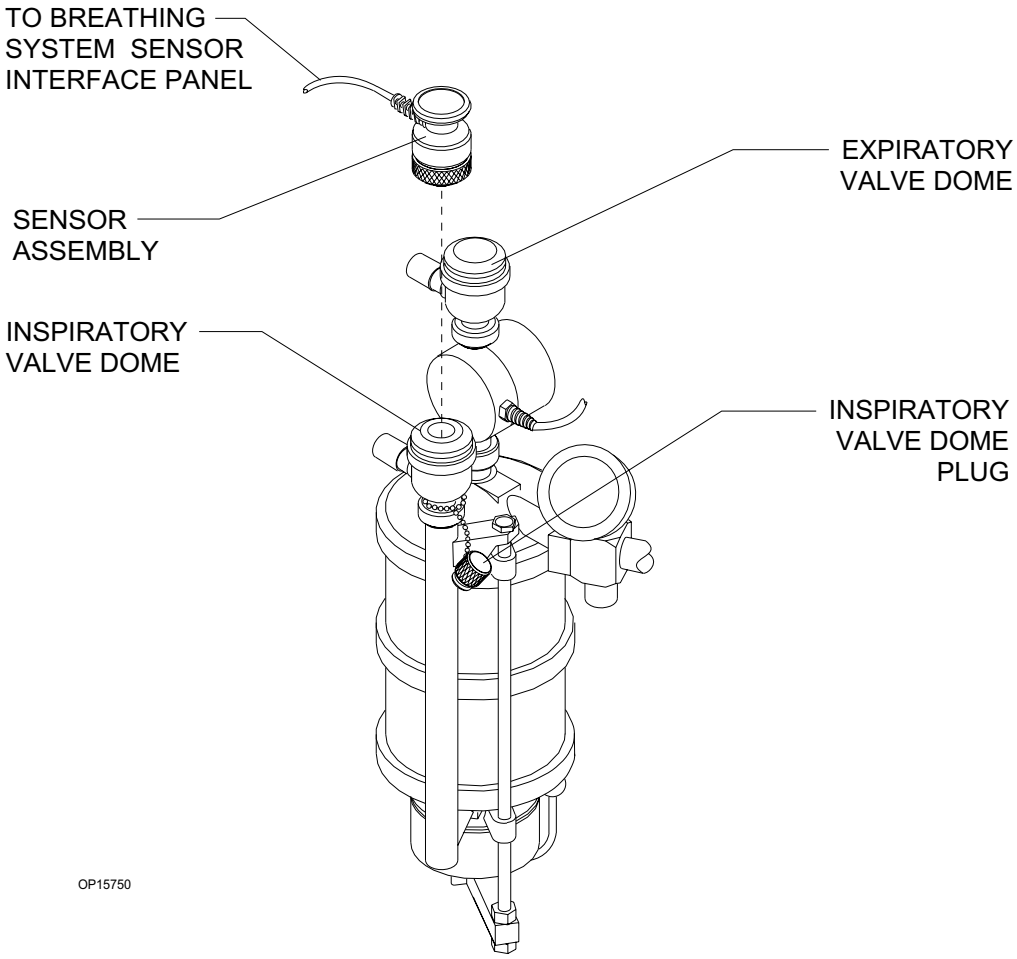
3. To save the new value, simply stop pressing keys.

   In five seconds, the highlighting box disappears and the new value is saved as the alarm limit.

Calibrating the Oxygen Sensor

To calibrate the oxygen sensor correctly, make sure it is exposed only to room air during the entire calibration period. You should calibrate the oxygen sensor as part of the daily preoperative setup of the anesthesia equipment.

1. Remove the sensor assembly from the inspiratory valve dome and close off the dome with the inspiratory valve dome plug. (Do not disassemble the sensor assembly further.)



2. Expose the sensor to ambient air only (21% oxygen concentration) and allow it to stabilize for several minutes. To ensure an ambient air exposure, hold the sensor away from any open part of the breathing system.

3. With the sensor exposed only to room air, press the O2 CAL key.

   Calibration begins.

4. View the monitor screens to track progress of the calibration.

   - During calibration, the following messages are displayed:

Display Area	Messages
Central Alarm Display	O2 NOT CAL
	O2 ALRM OFF
% OXYGEN Display	CALIBRATING

   - Following successful calibration, these messages are removed, and the currently sensed oxygen concentration appears in the % OXYGEN display. (If the calibration was not successful, the % OXYGEN display area is blank. See “Unsuccessful Calibration” in this section for further information.)

     Typically, calibration lasts less than 30 seconds. However, the time may vary depending on the amount of oxygen the sensor was exposed to before calibration.

Oxygen Exposure	Typical Calibration Time
21%	10 seconds
> 21%	up to 50 seconds

5. When the Narkomed 2B has successfully completed calibration, pull the inspiratory valve dome plug and reinsert the sensor assembly.

Unsuccessful Calibration

If, at the end of the calibration period, the % OXYGEN display area remains blank, the calibration was not successful. (This condition is also indicated by the Advisory messages O2 SENS ERR, O2 NOT CAL, and O2 ALRM OFF in the central alarm display.)

Causes and Solutions

An unsuccessful calibration can be caused by several conditions.

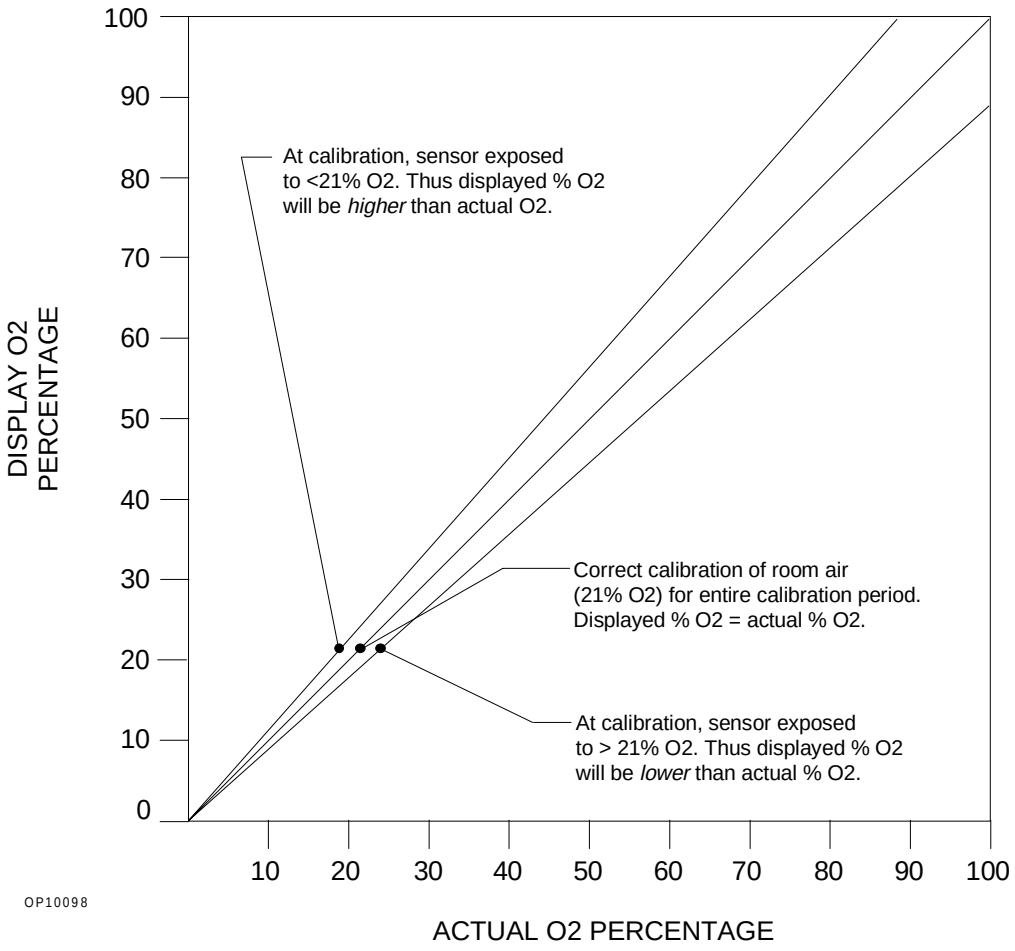
Cause	Solution
Sensor was exposed to an excessively lean or excessively rich oxygen calibration mixture.	Make sure that the sensor is exposed to room air only for the entire calibration period.
Sensor was exposed to a constantly changing calibration mixture.	Make sure that the sensor is exposed to room air only for the entire calibration period.
Sensor has not received the proper waiting period.	If the sensor capsule has been removed from the sensor assembly, a waiting period equal to the time that the capsule spent outside the sensor assembly (up to one week) is necessary. New sensors require a 15 minute waiting period.
Sensor is exhausted.	If the oxygen sensor has decayed beyond its useful service life (see the “Specifications” section of the manual), replace the decayed sensor with a new sensor and allow the proper waiting period.
Sensor is defective.	If there is too great a difference between the outputs of the two sensor halves, replace the defective sensor with a new sensor and allow the proper waiting period.
Sensor is disconnected.	When the sensor is disconnected, the display area is blank, and the following messages appear on the central alarm display: 02 SENS DISC, 02 NOT CAL, and 02 SENS DISC. If this happens, reconnect the sensor cord to the interface panel on the Narkomed 2B and press the O2 CAL key again.

Section 5 - Operation
Oxygen Monitoring

Consequences

If the oxygen sensor is improperly calibrated, it can cause inaccurate measurements. When a calibration gas mixture is excessively rich or lean in oxygen, the Narkomed 2B will not complete an attempted calibration; however, if the calibration gas is rich or lean but is within certain limits, the Narkomed 2B will complete the calibration. As a result, when displaying sensor measurements, the Narkomed 2B displays an oxygen percentage either greater or less than the actual oxygen percentage. Therefore, make sure that the sensor is exposed only to room air during the entire calibration period.

The following figure illustrates the relationship between the calibration mixture and the accuracy of oxygen measurement.



Oxygen Alarm Messages

The following list contains all warning, caution and advisory alarms associated with oxygen monitoring.

% OXYGEN LOW (Warning)

The Narkomed 2B continuously compares the current inspiratory oxygen percentage with the preset low oxygen alarm limit. If the measured oxygen concentration falls below the low alarm limit, the Warning message % OXYGEN LOW appears on the central alarm display and a continuous audible alarm sounds.

% OXYGEN HIGH (Advisory)

If the measured inspiratory oxygen concentration exceeds the preset high alarm limit, the Advisory message % OXYGEN HIGH appears on the central alarm display and a single-tone audible alarm sounds.

O2 SENS DISC (Advisory)

If the oxygen sensor cord becomes disconnected (or is damaged enough to cause an open circuit), the Advisory message O2 SENS DISC appears on the central alarm display and a single-tone audible alarm sounds. These additional messages are displayed as well: O2 NOT CAL and O2 ALARM OFF. Also, since cord disconnection invalidates the calibration, the % OXYGEN display area is blank.

If you then plug the sensor cord back into the interface panel, the O2 SENS DISC message is removed from the central alarm display, and the % OXYGEN display area remains blank until you perform a new calibration.

O2 SENS ERR (Advisory)

During oxygen sensor calibration and monitoring, the Narkomed 2B checks for a difference between the outputs of the two sensor halves. If the difference exceeds a predetermined percentage, the Advisory message O2 SENS ERR appears on the central alarm display.

During oxygen sensor calibration, the Narkomed 2B also checks the sensor's output against a range of acceptable output voltages. There are three possible causes for deviation from within this range.

- *Exhausted sensor.* If the sensor's capacity is exhausted, its output voltage will not meet the required minimum.
- *Incorrect calibration environment.* If the sensor is exposed to an excessively rich or lean oxygen concentration during calibration, the sensor's output will be above or below the acceptable output range.
- *Improper waiting.* If the proper waiting period is not allowed for a new sensor or for a sensor removed from the sensor housing, the sensor's output may be above or below the acceptable output range.

If a sensor error condition is detected during monitoring, the Advisory message O2 SENS ERR appears on the central alarm display, but operation can continue. If the monitor detects this condition during

calibration, the calibration will be invalidated, as shown by a blank % OXYGEN display area at the end of the calibration period, and the Advisory messages O2 NOT CAL, O2 ALRM OFF, and O2 SENS ERR.

O2 CAL DUE (Advisory)

The Advisory message O2 CAL DUE appears on the central alarm display when more than 18 hours have elapsed since the last calibration.

O2 NOT CAL (Advisory)

The Advisory message O2 NOT CAL appears on the central alarm display in the following circumstances:

- the oxygen sensor enters a noncalibrated state
- an attempt to calibrate the oxygen sensor was unsuccessful

O2 ALRM OFF (Advisory)

The Advisory message O2 ALRM OFF appears on the central alarm display when the patient alarms for the O2 analyzer are disabled. This message always occurs in conjunction with the O_2 NOT CAL message.

O2 CAL ERR (Advisory)

The Advisory message O2 CAL ERR appears on the central alarm display when the sensor is improperly calibrated. This message may appear during monitoring or during calibration.

During monitoring, if the calculated oxygen concentration exceeds 103%, the Advisory message O2 CAL ERR appears on the central alarm display and remains there until a new calibration is performed. (A calculated oxygen concentration of 100% is displayed for all values ≥ 100%.)

During monitoring, if the calculated oxygen percentage exceeds 105%, the oxygen analyzer invalidates the present calibration. The display area is blanked, and the Advisory messages O2 CAL ERR, O2 NOT CAL, and O2 ALRM OFF appear on the central alarm display. The display area remains blank until a new calibration is performed.

During calibration, if the sensor is exposed to a constantly changing gas mixture, the calibration will be invalidated; the O2 CAL ERR Advisory message will also replace the O2 SENS ERR message normally used for an invalidated calibration.

Low Oxygen Supply Whistle

If the Narkomed 2B is configured to do so, it sounds a 7-second whistle when the oxygen supply drops too low to properly pressurize the fresh gas circuit (below about 37 psi). If this alarm sounds, it cannot be silenced.

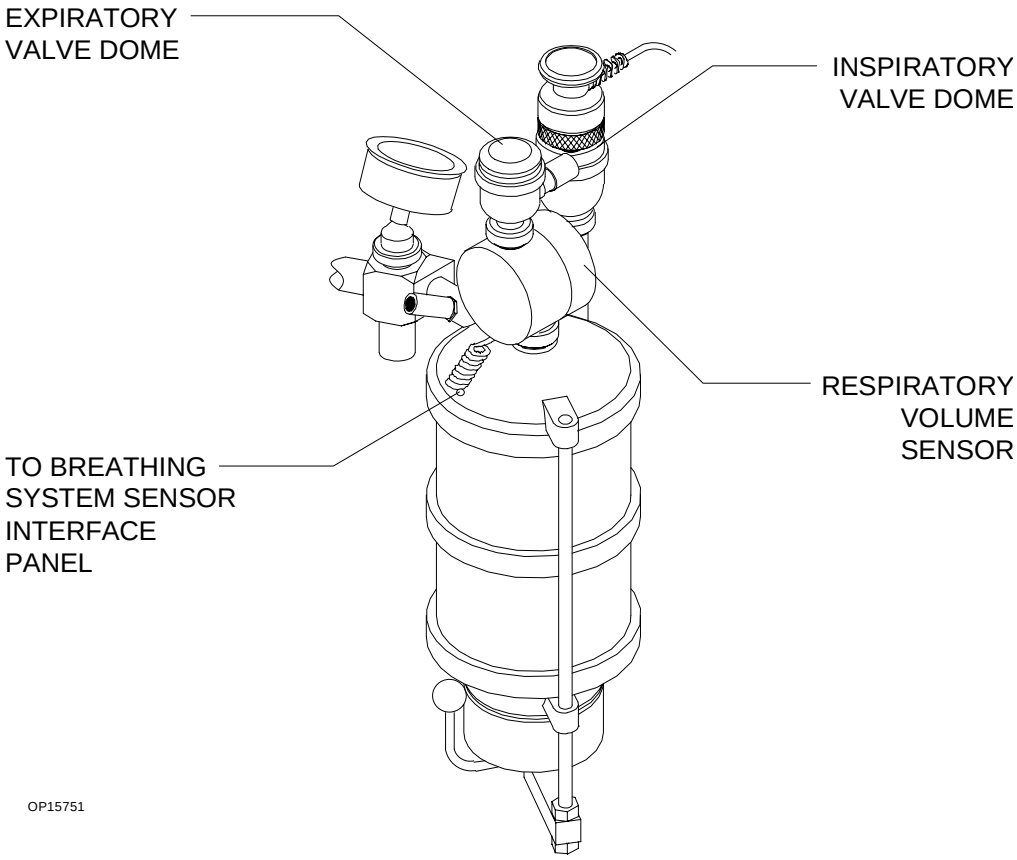
Problem Resolution

Problem	Possible Cause	Remedy
Display area remains blank when a reading is expected. O2 NOT CAL & O_2 ALRM OFF messages appear on the central alarm display.	Calibration is necessary.	Perform proper calibration. Remove sensor assembly from breathing circuit and press O2 CAL key. Make sure sensor is exposed only to room air.
O_2 analyzer fails to remember calibration alarm display but monitor continues to function.	Backup memory power is not available.	Allow anesthesia machine back-up battery to recharge.
	The hardware malfunctioned.	Contact NAD qualified technical service representative.
Pressing O2 CAL key does not initiate calibration.	Sensor cord is disconnected.	Reconnect sensor cord to input receptacle on anesthesia machine.
	Sensor cord is damaged.	Replace housing/cord assembly.
Display area has no pressure readout during ventilation.	Pilot line is not connected.	Ensure that pilot line is properly connected.
	Pilot line is occluded or kinked.	Ensure that lumen of pilot line is free of obstructions.
Readings are erratic.	Condensate has accumulated in pilot line.	Drain and reconnect pilot line.

Problem	Possible Cause	Remedy
Pressing O2 CAL key initiates calibration, but display window remains blank at end of calibration period.	Sensor is exposed to incorrect oxygen concentration.	Expose sensor to room air for 21% calibration.
	Sensor is exposed to constantly changing calibration mixture	
	Sensor capsule had been removed from housing for a prolonged period of time.	Allow for waiting period equal to duration of capsule removal.
	New capsule was not given proper waiting period.	Allow for 15 minute waiting period.
	Sensor capsule is exhausted or defective.	Replace sensor capsule. Allow for 15 minute waiting period.
During monitoring, O_2 SENS DISC, O_2 ALRM OFF & O_2 NOT CAL messages appear on central alarm display.	Sensor housing and cable are defective.	Replace housing/cable assembly.
	Sensor cord is disconnected.	Reconnect sensor cord to input receptacle on anesthesia machine.

Overview

Respiratory volume is measured by a respiratory sensor which is attached to the expiratory valve and mounted to the top of the absorber assembly. The sensor uses a positive displacement rotating-lobe impeller that generates electronic pulses in response to the patient's expiratory flow. These pulse patterns are converted into meaningful readings for minute volume, tidal volume, and respiratory rate displays.



CAUTION: Although the Narkomed 2B is designed to minimize the effects of ambient radio-frequency interference, the functioning of the respiratory volume monitor may be adversely affected by the operation of electrosurgical equipment or short wave or microwave diathermy equipment in the vicinity.

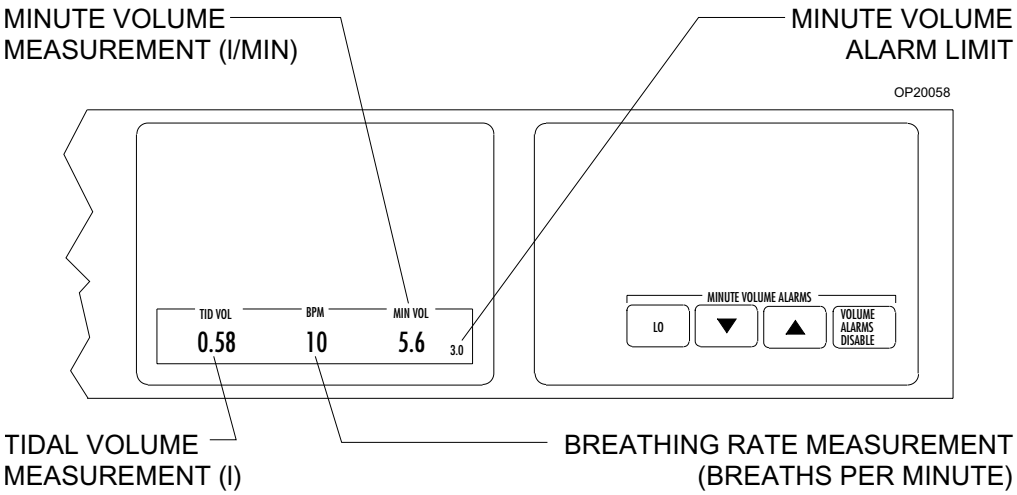
NOTE: Sudden, irregular expiratory flow may cause erratic tidal volume and respiratory rate displays. To avoid such erroneous measurements, defer reading the display until a full minute has elapsed after the irregular flow has stopped.

Section 5 - Operation
Respiratory Volume Monitoring

Monitor Displays

Information about the patient's respiratory volume is presented on the two monitor screens.

- **Left-Hand Screen**—You can display the minute volume trend on this screen by pressing the TREND key until the minute volume graph appears.
- **Right-Hand Screen**—Numerical values for tidal volume, respiratory rate, and minute volume are shown on the right-hand screen.



– **The tidal volume measurement (TID VOL)** shows the volume for each breath. If the monitor does not detect a valid breath within a 30-second period, the display area goes blank.

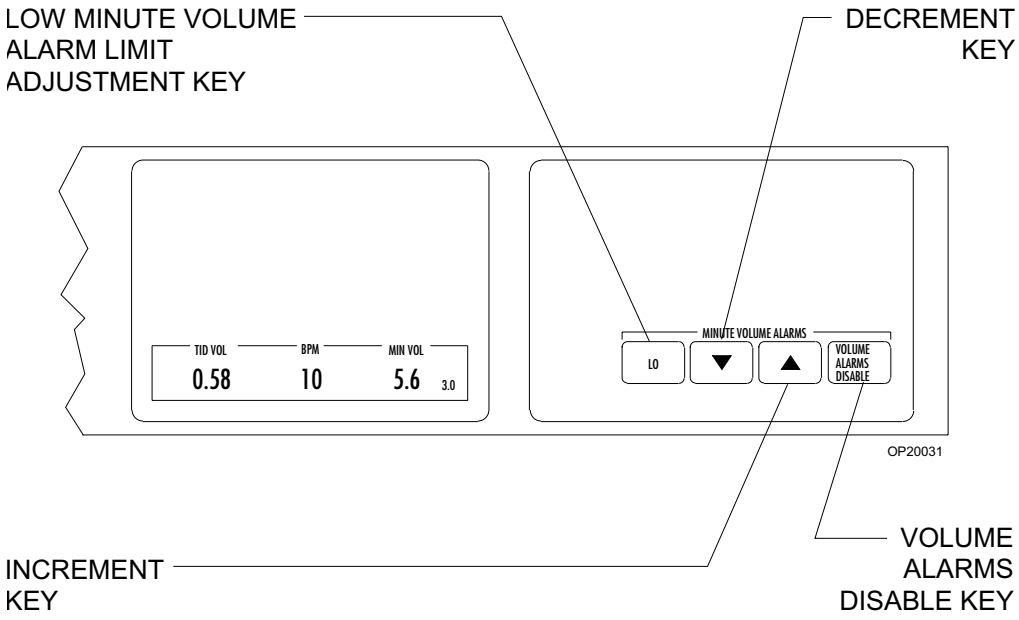
– **The breathing rate measurement (BPM)** displays the number of breaths during the previous minute of respiration. If the BPM display is blank, a full minute of respiration has not occurred.

– **The minute volume measurement (MIN VOL)** continuously shows the volume of exhaled gas accumulated during the previous minute of respiration. A blank MIN VOL display area indicates that a full one-minute history of exhaled volume is not available.

The minute volume alarm limit, to the right of the minute volume reading, is the volume below which an alarm condition occurs.

Monitor Controls

You use the minute volume alarm keys to set minute volume alarm limits and to turn the volume alarms on and off. These keys are in the bottom row of the key bank to the right of the right-hand display screen.



Fixed alarms are provided for low tidal volume, low minute volume, and reverse flow through the sensor. Apnea volume alarms are generated at 15 seconds (Caution) and 30 seconds (Warning) if the respiratory volume monitor does not sense a valid breath.

The Narkomed 2B's volume alarms are automatically enabled when the ventilator power switch is turned to the ON position. A disconnected sensor causes a sensor disconnect alarm.

Section 5 - Operation
Respiratory Volume Monitoring

Setting the Minute Volume Low Alarm Limit

If the low minute volume falls below the minute volume low alarm limit, an alarm condition occurs. The alarm limit is automatically set to a default of 3.0 liters at power-up. You can change the default to a value within the range of 0.5–10.0 liters.

Follow these steps to adjust the minute volume low alarm limit:

1. Press the LO minute volume alarm key.

   A box is drawn around the minute volume low alarm limit.

2. Press the increment (up arrow) or decrement (down arrow) key to increase or decrease the highlighted alarm limit.

   If you do not press a key within five seconds, the highlighting box disappears. To begin again, return to step 1.

3. To save the new value, simply stop pressing keys.

   In five seconds, the highlighting box disappears and the new value is saved as the alarm limit.

Controlling Volume Alarms

You can alternately enable and disable the respiratory volume alarms with the VOLUME ALARMS DISABLE key.

VOLUME ALARMS DISABLE

- To disable working respiratory volume alarms, press the VOLUME ALARMS DISABLE key.

  The VOL ALRM OFF message appears on the central alarm display.

- To enable disabled respiratory volume alarms, press the VOLUME ALARMS DISABLE key.

  The VOL ALRM OFF message disappears from the central alarm display.

  NOTE: The minute volume and apnea volume alarms are automatically disabled on power-up to prevent nuisance alarms during patient setup. The alarms are automatically enabled when you turn on the ventilator. You can also manually enable the alarms by pressing the VOLUME ALARMS DISABLE key.

Respiratory Volume Alarm Messages

The following list contains all warning, caution and advisory alarms associated with respiratory volume monitoring.

APNEA-VOL (Warning/ Caution)

The Narkomed 2B continuously monitors the expiratory flow in the patient breathing system. By processing the expiratory flow pattern, the monitor can determine if a “valid” breath has occurred. A “valid” breath has a tidal volume of 80 ml or greater.

If a valid breath is not detected for an interval of 15 seconds, a red APNEA LED indicator lights continuously, the Caution message APNEA-VOL appears on the central alarm display, and an intermittent audible alarm sounds.

If a valid breath is not detected for an additional 15 seconds (30 seconds total), the red APNEA LED indicator flashes on and off, the Caution message APNEA-VOL is upgraded to a Warning on the central alarm display, and a continuously repeating audible alarm sounds. Also, the display area pertaining to the Respiratory Volume Monitor goes blank.

When a valid breath is detected, alarm annunciation ceases and a tidal volume measurement appears in the display window. However, a full minute of respiratory activity must be registered before the minute volume and respiratory rate appear.

NOTE: Volume-related alarms can be disabled with the VOLUME ALARMS DISABLE key.

MIN VOL LOW (Caution)

Whenever the Narkomed 2B measures a minute volume less than the minute volume low alarm limit, the Caution message MIN VOL LOW appears on the central alarm display and an intermittent audible alarm sounds.

REVERSE FLOW (Advisory)	If a reverse flow through the sensor in excess of 20 ml is detected, the Advisory message REVERSE FLOW appears on the central alarm display and a single-tone audible alarm sounds. A forward flow greater than 20 ml clears the alarm condition. The REVERSE FLOW alarm message remains on the screen for 10 seconds after the resumption of forward flow to enable you to recognize an intermittent reverse flow condition.
VOL SENS DISC (Advisory)	If the respiratory volume sensor cord is not properly connected to its input receptacle on the anesthesia machine (or if the cord is damaged enough to cause an open circuit), the Advisory messages VOL SENS DISC and VOL ALRM OFF appear on the central alarm display. The digital and bar graph display areas also go blank. Reconnecting the sensor cord clears the alarm condition.
VOL ALRM OFF (Advisory)	When the volume alarms have been disabled, the Advisory message VOL ALRM OFF appears on the central alarm display. This alarm condition is also generated by a disconnect of the sensor cord.
VOL ALARMS STBY (Advisory)	When the volume alarms have been set to Standby, the Advisory message VOL ALARMS STBY appears on the central alarm display.

Problem Resolution

PROBLEM	POSSIBLE CAUSE	REMEDY
Blank display area	One full minute has not elapsed (for Minute Volume and Respiratory Rate) since respiration began	Wait one minute to read display.
	Apnea condition	Correct apnea condition.
Blank display area, VOL SENS DISC and VOL ALRM OFF alarm messages on central alarm display	Sensor cord disconnected	Reconnect sensor cord plug to interface panel on anesthesia machine.
	Sensor cord damaged	Repair sensor cord.
REVERSE FLOW alarm message on central alarm display	Leak between sensor and expiratory valve	Check gasket; make sure it is in good condition and is seated properly.
	Expiratory valve not closing completely during inspiration	Check expiratory valve disc and pins. Clean, repair, or replace expiratory valve.
	Defective sensor	Repair or replace sensor.
Tidal volume readings obtained are consistently low and sensor is noisy during operation	Excessive friction in sensor	Lubricate, repair, or replace sensor.

RETURN TO CD-ROM TABLE OF CONTENTS

Section 5 - Operation
Breathing Pressure Monitoring

Overview

Breathing pressure is measured with a solid-state pressure transducer that can sense pressure at either the absorber or patient Y-piece, depending on which pilot line is used.

Choice of Breathing Pressure Monitoring Location

North American Dräger has no control over the type of breathing hoses and Y-pieces that are ultimately used with NAD absorber systems and pressure monitors—specifically, whether such user-supplied components include a terminal for pressure monitoring at or near the Y-piece. In order to ensure that some form of pressure monitoring is always used, provisions have been made for pressure monitoring at the absorber (the quick-connect fitting on the absorber gas pipe). However, do not construe this provision for monitoring at the absorber as a recommendation from North American Dräger for this pressure monitoring location.
In fact, arguments can be made for pressure monitoring at either the Y-piece or at the absorber. Advocates of Y-piece pressure monitoring first claim that it more accurately reflects the pressure developed in the patient's lungs. They also claim that a blocked breathing system can be more easily detected with this method when compared with pressure monitoring at the absorber.

For example, if the inspiratory breathing hose became kinked or blocked during automatic ventilation, the ventilator bellows would continue to cycle against the blocked hose. A pressure monitor connected at the Y-piece (downstream of the occlusion) could sense either an absence of pressure fluctuation and alarm, or could sense a reduced pressure fluctuation (below the threshold pressure alarm limit) and alarm. In contrast, a pressure monitor connected at the absorber (upstream of the occlusion) could sense a pressure fluctuation above the threshold pressure alarm limit, and thus would not alarm. (Both of these scenarios assume that the occlusion does not cause a peak pressure high enough to activate the peak pressure alarm, which is meant to detect pressures likely to cause barotrauma.)

However, North American Dräger disagrees with the idea of relying on pressure monitoring to detect a blocked breathing circuit. Carbon dioxide monitoring and respiratory flow monitoring provide superior detection of blocked breathing paths when compared to pressure monitoring, which detects such conditions only in some instances. North American Dräger pressure monitors are therefore not promoted for detection of blocked breathing paths.

Further, Y-piece pressure monitoring has several disadvantages that could collectively cause the operator to neglect connecting the pressure monitoring pilot line. Examples include increased contamination of the pilot line due to its proximity to secretions, buildup of condensation within the pilot line, and the introduction of additional disconnection points (if the pilot line connects to a 15 mm adapter).

In conclusion, the responsibility for the selection of pressure monitoring at either the absorber or the Y-piece rests with you, the operator. Your

clinical considerations, over which North American Dräger has no control, must be included in this decision. North American Dräger is available to discuss with you in detail the positive and negative aspects of each pressure monitoring approach.

Installing the Breathing Pressure Pilot Line

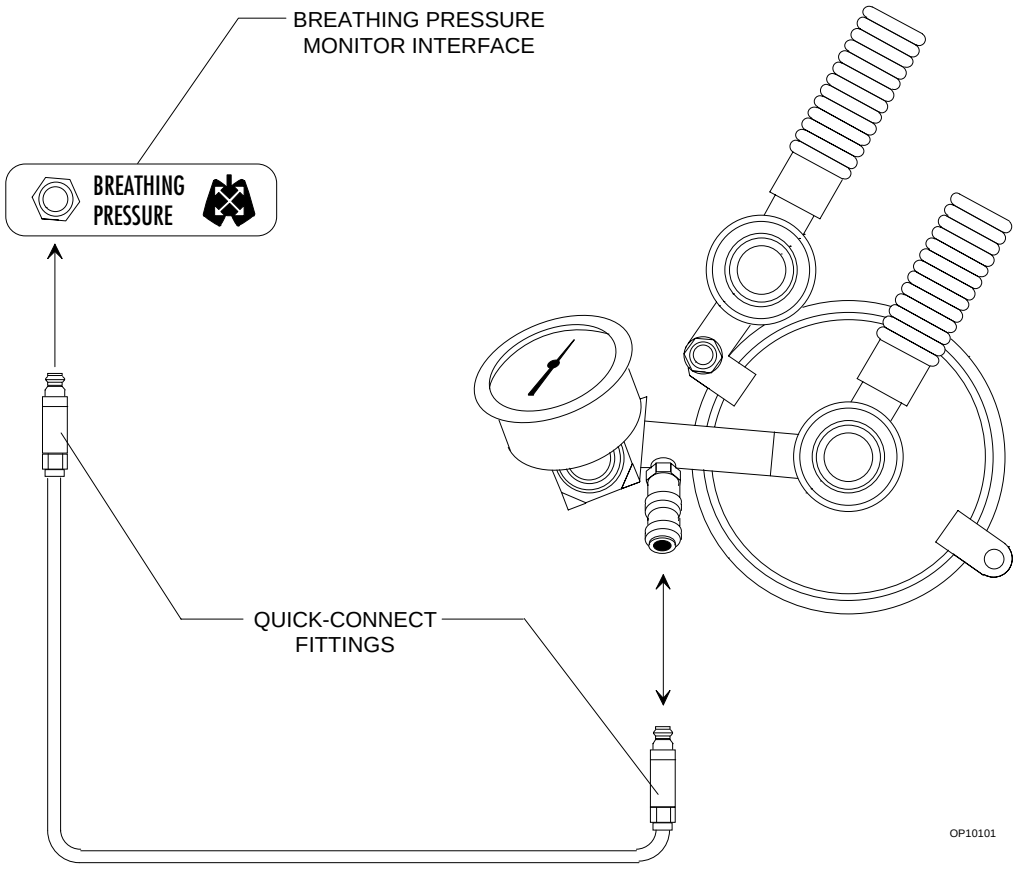
North American Dräger anesthesia systems are supplied with two breathing pressure pilot lines: a shorter one for breathing pressure monitoring at the absorber, and a longer line for breathing pressure monitoring at the Y-piece. For either type of pilot line, check the line for obstructions and moisture accumulation before and during use.

Installing the Absorber Pilot Line

For breathing pressure monitoring at the absorber, install the shorter pilot line (which has quick-connect fittings on both ends) as follows:

1. Insert one quick-connect fitting on the pilot line into the quick-connect fitting mounted on the rear of the gas pipe that extends from the absorber top assembly. (The absorber quick-connect fitting has a self-closing construction, and can be left unused when employing the longer pilot line.)

2. Insert the other quick-connect fitting into the quick-connect fitting on the breathing pressure monitor interface panel.

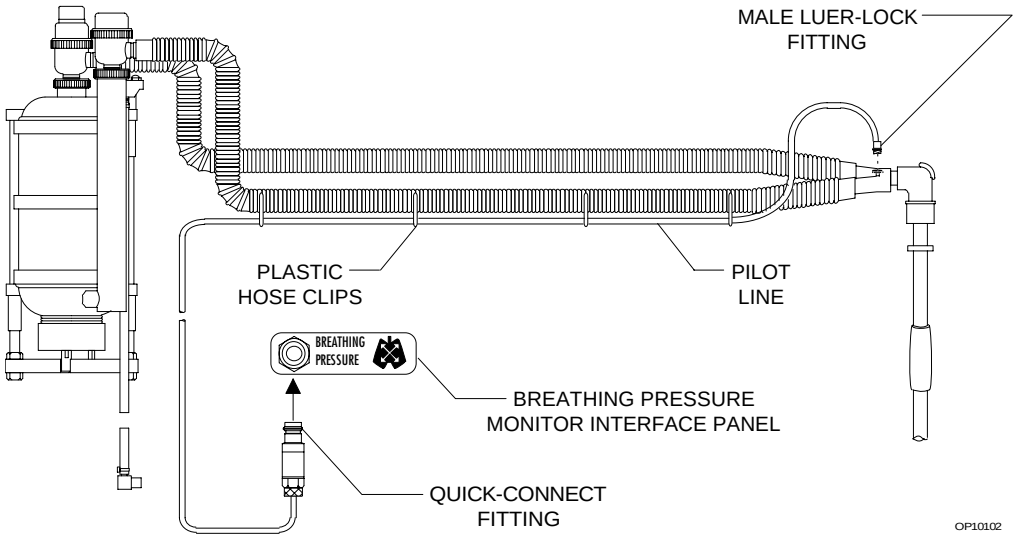


Installing the Y-piece Pilot Line

For breathing pressure monitoring at the patient Y-piece, install the longer pilot line (which has a quick-connect fitting on one end and a Luer type fitting on the other end) as follows:

1. Insert the quick-connect fitting on the pilot line into the quick-connect fitting on the breathing pressure monitor interface panel.

2. Insert the Luer fitting on the pilot line with a Luer fitting on either the patient Y-piece or a 15 mm adapter on the patient side of the Y-piece. Use the four plastic hose clips attached to the pilot line to mount it on either of the breathing hoses leading to the Y-piece.



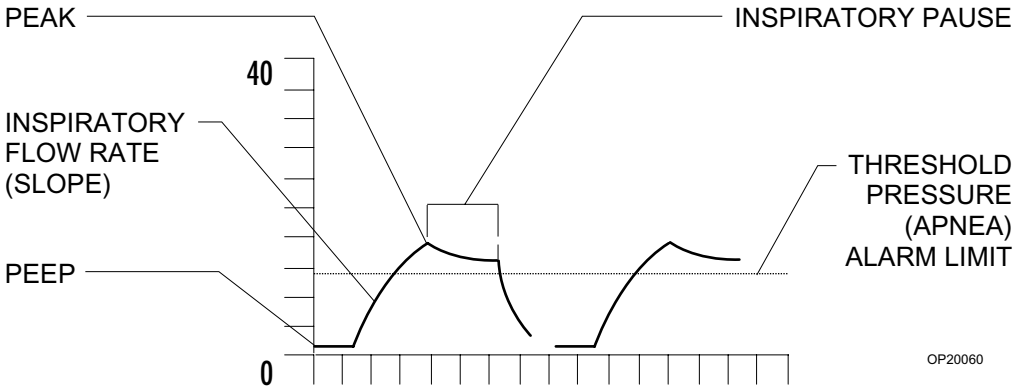
Section 5 - Operation
Breathing Pressure Monitoring

Monitor Displays

Information about the patient's breathing pressure is presented on the two monitor screens.

- **Left-Hand Screen**—You can display the breathing pressure waveform or the breathing rate on this screen.

To display the breathing pressure waveform, press the TRACE key.



  – The amount of pressure that the baseline is raised from zero corresponds to the patient's positive end expiratory pressure (PEEP).

  – The peak of the waveform corresponds to the peak pressure.

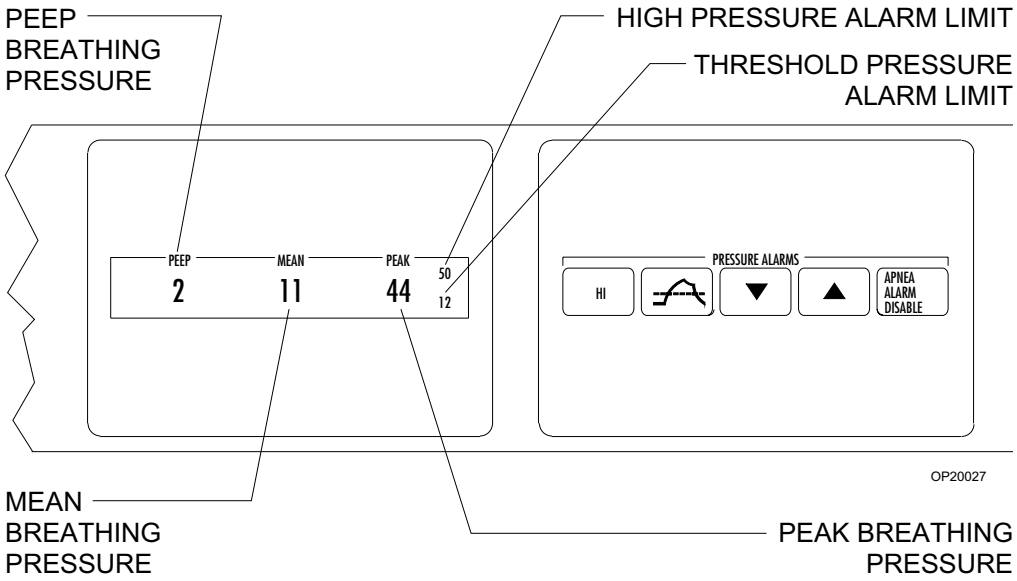
  – The slope of the trace as it rises toward the peak pressure is correlated with the inspiratory flow rate; the steeper the slope, the higher the flow rate.

  – The length of the plateau from peak pressure to the decrease in pressure corresponding to expiration is equivalent to the length of the inspiratory pause (if present).

  – The horizontal dotted line on the waveform represents the threshold pressure (apnea) alarm limit. The dotted line appears only when the trace is scaled for 0–40 cmH_20. The Narkomed 2B uses this scale when the pressure high alarm limit is set on or below 60 cmH_20. Adjustment of the pressure high alarm limit is described later in this section.

To display the breathing rate, press the TREND key until the breathing rate graph appears.

- **Right-Hand Screen**—Numerical values for PEEP (positive end expiratory pressure), mean, and peak breathing pressure are shown on the right-hand screen.



The PEEP pressure is the pressure at the end of exhalation.

The mean pressure represents the average of all the instantaneous pressure values recorded during each breath.

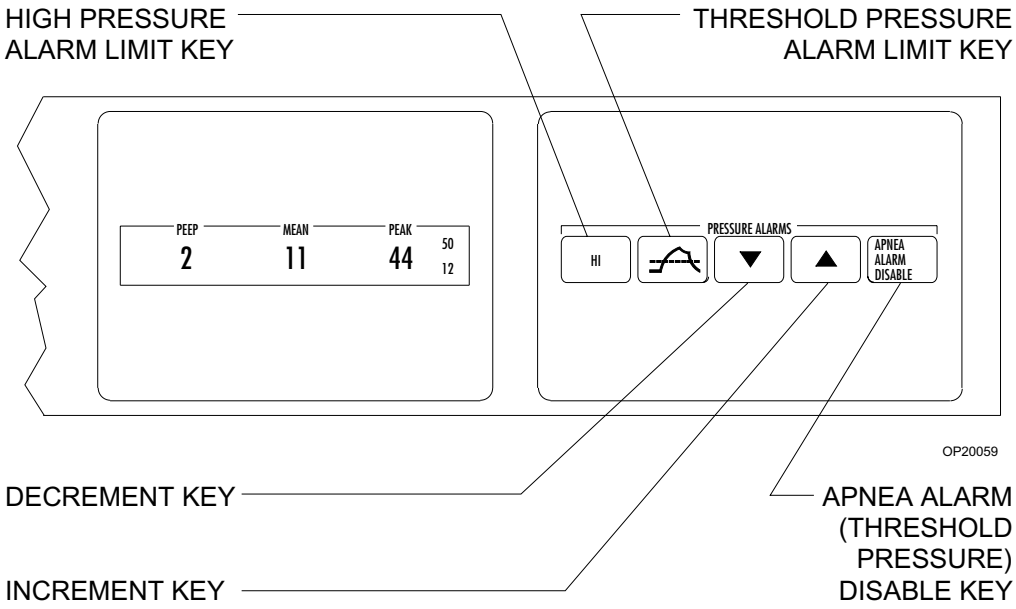
The peak pressure is the highest instantaneous pressure value for each breath.

To the right of the peak variable, in small type, are two alarm limits. The upper number is the pressure high alarm limit; the lower number is the threshold pressure alarm limit.

Section 5 - Operation
Breathing Pressure Monitoring

Monitor Controls

You use the pressure alarm keys to set breathing pressure alarm limits and to turn the apnea alarm on and off. These keys are in the middle row of the key bank to the right of the right-hand display screen.



Setting the Pressure High Alarm Limit

The pressure high alarm limit is automatically set to 50 cmH_2O at power-up. You can change this limit within the range of 30 to 125 cmH_2O.

NOTE: If you set the pressure high alarm limit on or below 60 cmH_2O, the breathing pressure waveform is scaled from 0–40 cmH_2O. If you set the alarm limit higher than 60 cmH_2O, the waveform is scaled from 0–125 cmH_2O. At this broader scale, the threshold pressure alarm limit (a horizontal dotted line) is not shown with the trace.

To adjust the pressure high alarm limit, follow these steps:

1. Press the HI alarm limit key.

   A box is drawn around the pressure high alarm limit.

2. Press the increment (up arrow) or decrement (down arrow) key to increase or decrease the pressure high alarm limit.

   If you do not press a key within five seconds, the highlighting box disappears. To begin again, return to step 1.

3. To save the new value, simply stop pressing keys.

In five seconds, the highlighting box disappears and the new value is saved as the pressure high alarm limit.

Setting the Threshold Pressure Alarm Limit

The threshold pressure alarm limit is automatically set to 12 cmH_2O at power-up. You can change the threshold pressure alarm limit to any value within the range of 5–30 cmH_2O.

WARNING: The threshold pressure alarm limit should be as close as possible to the sensed peak pressure without exceeding it. For details, see the following "Threshold Limit Guidelines" and "Sample Threshold Limit Settings."

To change the threshold pressure alarm limit, follow these steps:

1. Press the threshold pressure alarm limit key (shown above-left).

   A box is drawn around the threshold pressure alarm limit.

2. Press the increment (up arrow) or decrement (down arrow) key to increase or decrease the threshold pressure alarm limit.

   If you do not press a key within five seconds, the highlighting box disappears. To begin again, return to step 1.

3. To save the new value, simply stop pressing keys.

   In five seconds, the highlighting box disappears and the new value is saved as the threshold pressure alarm limit.

Threshold Limit Guidelines

If a breathing system leak or partial disconnection occurs when the threshold pressure alarm limit is set significantly lower than the peak pressure, continued positive pressure ventilation can produce a pressure fluctuation great enough to exceed the threshold (and thereby satisfy the alarm), yet not great enough to provide adequate ventilation.

To address the problem, the Advisory message THRESHOLD LO appears on the central alarm display under the following conditions:

- When the sensed peak pressure exceeds the set threshold by more than 6 cmH_2O at threshold pressure alarm limit settings of 5–20 cmH_2O.

- When the sensed peak pressure exceeds the set threshold by more than 8 cmH_2O at threshold pressure alarm limit settings of 21–29 cmH_2O.

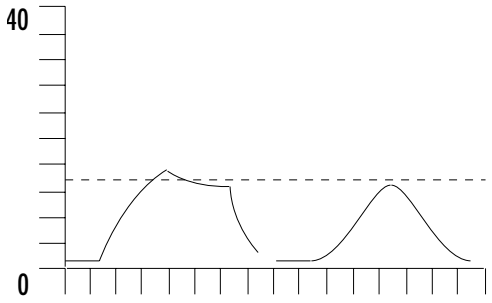
Section 5 - Operation
Breathing Pressure Monitoring

Sample Threshold Limit Settings

The figure below illustrates the effects of correct and incorrect settings of the threshold pressure alarm limit. Threshold pressure is not shown on the wavefrom when the scale is 0–125 cmH_2O.

CORRECT

BREATHING PRESSURE CmH2O

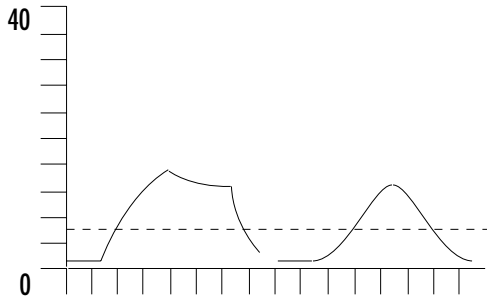


1.Threshold pressure alarm limit correctly set to within 6cm H2O of peak pressure (for alarm limit settings of 5 through 20cm H2O).

2.Thus after partial breathing system disconnection or leak, small pressure fluctuation does not cross threshold pressure alarm limit. Operator is warned of apnea condition.

INCORRECT

BREATHING PRESSURE CmH2O



1.Threshold pressure alarm limit incorrectly set more than 6cm H2O below peak pressure.

2.Thus after partial breathing system disconnection or leak, small pressure fluctuation in system satisfies incorrectly set threshold pressure alarm limit. Operator is not alerted to apnea condition.

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Controlling the Apnea Alarm

You can alternately enable and disable the breathing pressure apnea alarm with the APNEA ALARM DISABLE key.

- To disable a working alarm, press the APNEA ALARM DISABLE key.

  The APNEA-P OFF message appears on the central alarm display.

- To enable a disabled alarm, press the APNEA ALARM DISABLE key.

  The APNEA-P OFF message disappears from the central alarm display.

NOTE: The apnea alarm is automatically disabled on power-up to avoid a spurious alarm with a spontaneously breathing patient. When you turn on the ventilator, the alarm is automatically enabled (or you can enable it manually with the APNEA ALARM DISABLE key). The alarm remains enabled even if you turn off the ventilator, unless you manually disable it by pressing the APNEA ALARM DISABLE key.

Section 5 - Operation
Breathing Pressure Monitoring

Breathing Pressure Alarm Messages

The following list contains all warning, caution and advisory alarms associated with breathing pressure monitoring.

APNEA-PRES (Warning/Caution)

If the measured breathing pressure remains below the threshold pressure alarm limit for more than 15 seconds, the Caution message APNEA-PRES appears on the central alarm display and an intermittent audible alarm sounds.

If the breathing pressure remains below the threshold pressure for an additional 15 seconds (30 seconds total), the Caution message APNEA-PRES is upgraded to a Warning on the central alarm display. During the Warning condition, the breathing pressure display area is cleared and a continuously repeating audible alarm sounds.

VENT PRES HI (Warning)

If the measured breathing pressure exceeds the high pressure limit, the Warning message VENT PRES HI appears on the central alarm display and a continuously repeating audible alarm sounds.

This alarm condition is cleared when the measured breathing pressure drops below the high pressure alarm limit. However, the alarm message is extended for 5 seconds to allow for recognition of a momentary high pressure condition.

SUB ATM PRES (Warning)

If the measured breathing pressure falls below -10 cmH_2O, the Warning message SUB ATM PRES appears on the central alarm display and a continuously repeating audible alarm sounds.

This alarm condition is cleared when the sensed pressure rises above -10 cmH_2O. However, the alarm message is extended for 5 seconds to allow for recognition of a momentary subatmospheric pressure condition.

CONTNG PRES (Caution)

If the measured breathing pressure remains above the threshold pressure alarm limit for more than 15 seconds, the breathing pressure display area is cleared, the Caution message CONTNG PRES appears on the central alarm display, and an intermittent audible alarm sounds.

When the measured breathing pressure drops below the threshold pressure alarm limit, alarm annunciation ceases.

PEEP > 25 (Caution)

Any time that the monitor measures a PEEP of 26 cmH_2O or greater, the Caution message PEEP > 25 appears on the central alarm display and an intermittent audible alarm sounds.

Alarm annunciation ceases when the measured PEEP drops below 26 cmH_2O. Also, an APNEA or CONTINUING PRESSURE alarm condition will clear this alarm condition.

THRESHOLD LO (Advisory)

The Advisory message THRESHOLD LO appears on the central alarm display any time the sensed peak pressure exceeds the threshold pressure alarm limit by more than 6 cmH_2O at threshold pressure alarm limit settings of 5–20 cmH_2O, or by more than 8 cmH_2O at threshold pressure alarm limit settings of 21–29 cmH_2O. Setting the threshold pressure alarm limit at 30 cmH_2O disables the THRESHOLD LO advisory.

PEEP > 4 (Advisory)

Any time the monitor measures a PEEP of 5 cmH_2O or greater, the Advisory message PEEP > 4 appears on the central alarm display.

When the measured PEEP drops below 5 cmH_2O, the Advisory message is cleared from the display.

APNEA-P OFF (Advisory)

Any time that the apnea pressure alarm (threshold pressure alarm limit) has been disabled, the Advisory message APNEA-P OFF appears on the central alarm display. This Advisory is also generated automatically after power-up if the ventilator power switch is in the OFF position.

Problem Resolution

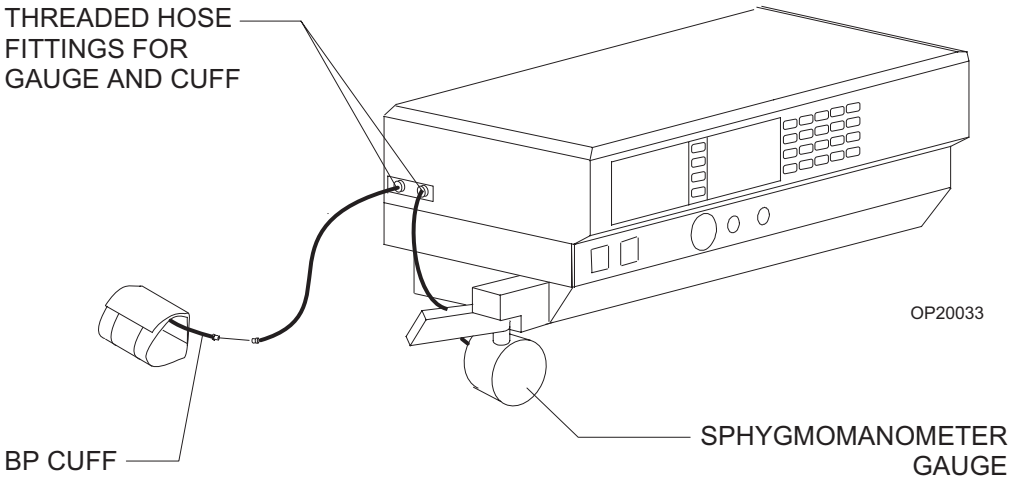
PROBLEM	POSSIBLE CAUSE	REMEDY
No pressure readout in display area during ventilation	Pilot line not connected	Make sure pilot line is properly connected.
	Pilot line blocked or kinked	Make sure that lumen of pilot line is free of obstructions.
Erratic readings	Condensation accumulation in pilot line	Drain and reconnect pilot line.

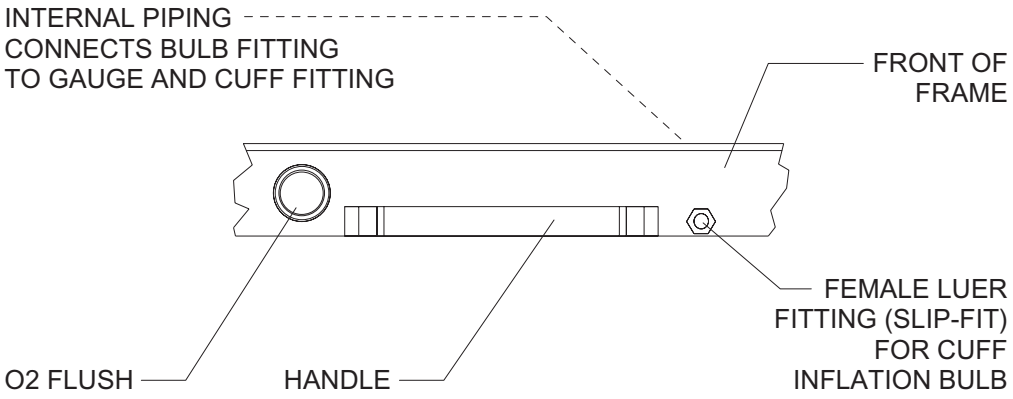
RETURN TO CD-ROM TABLE OF CONTENTS

Section 5 - Operation
Manual Sphygmomanometer

Overview

An aneroid manual sphygmomanometer can be mounted on the Narkomed 2B. The sphygmomanometer gauge is positioned on the left side of the anesthesia machine, next to the ventilator bellows. The cuff inflation bulb is located to the right of the oxygen flush button on the front of the machine.

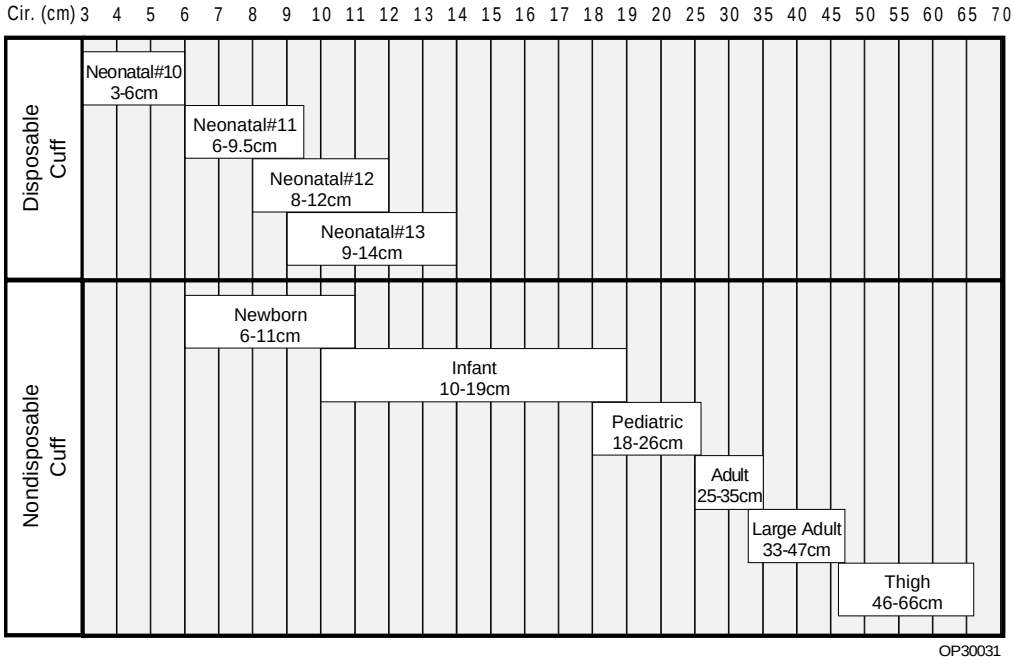



INTERNAL PIPING CONNECTS BULB FITTING TO GAUGE AND CUFF FITTING
FRONT OF FRAME
FEMALE LUER FITTING (SLIP-FIT) FOR CUFF INFLATION BULB
O2 FLUSH
HANDLE

Section 5 - Operation
Manual Sphygmomanometer

Selecting a Blood Pressure Cuff

When preparing for a case that includes noninvasive blood pressure monitoring, be sure to choose the correct cuff size and to place the cuff correctly. Use the following table to select the appropriate cuff size. If you don't have a tape measure, use the INDEX and RANGE lines marked on the cuff as described in "Placing the Cuff," below.


Cir. (cm) 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25 30 35 40 45 50 55 60 65 70
Disposable Cuff
Neonatal#10 3-6cm
Neonatal#11 6-9.5cm
Neonatal#12 8-12cm
Neonatal#13 9-14cm
Nondisposable Cuff
Newborn 6-11cm
Infant 10-19cm
Pediatric 18-26cm
Adult 25-35cm
Large Adult 33-47cm
Thigh 46-66cm
OP30031

Connecting the Cuff

To connect the cuff:

1. Connect the cuff hose (attached to the cuff) to the extension hose (with a threaded fitting on one end and a Luer lock fitting on the other end). Insert the Luer lock fitting on the cuff hose into the Luer lock fitting on the extension hose, and twist until they lock together.

2. Attach the other end of the extension hose to the fitting on the patient interface panel labeled BP CUFF. Hand-tighten the threaded hose fitting onto the threaded fitting of the interface panel.

3. Make sure that none of the hoses are pinched or kinked.

After connecting the manual sphygmomanometer, check the gauge's pressure indication. With zero pressure applied to the gauge and cuff, the gauge pointer should remain within the band marked on the face plate.

Placing the Cuff

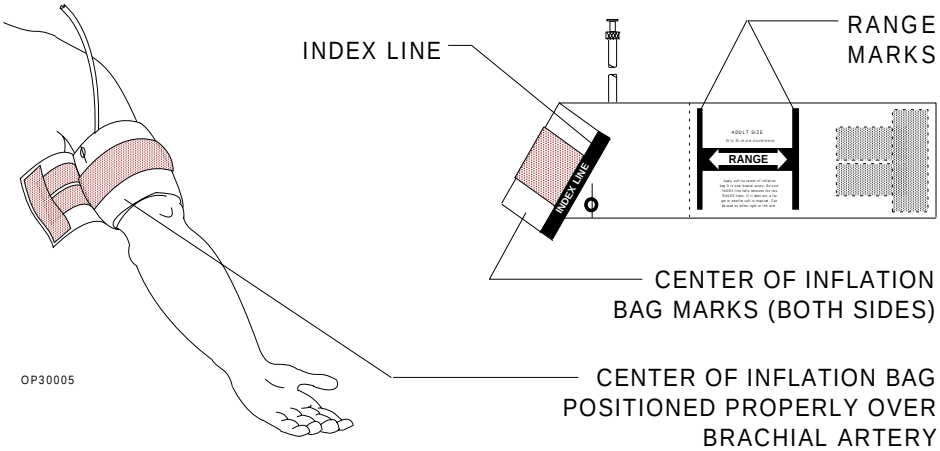
When fitting the cuff, place the center of the cuff inflation bag over the artery (for the brachial artery, place over the inside of the arm above the elbow). Make sure that the cuff fits securely on the limb and that the INDEX line falls between the two RANGE lines. If the INDEX line does not fall between the RANGE lines, select a smaller or larger cuff.

The cuff can be used on either the right or left extremity, but the left is usually preferred.

NOTE: Do not place the cuff on a limb being used for infusion.

For accurate blood pressure measurements, position the cuff at the same level as the patient's heart. Placing the cuff above the heart causes the reading to be falsely low; placing the cuff below the heart causes the reading to be falsely high. In instances where you cannot place the cuff at the same level as the heart, use the following general rule.

- For every inch of elevation above the heart, add 1.8 mmHg to the reading.
- For every inch of elevation below the heart, subtract 1.8 mmHg from the reading.



RETURN TO CD-ROM TABLE OF CONTENTS

Section 6
Routine Maintenance and Cleaning

Overview

This section outlines procedures for maintaining and cleaning the Narkomed 2B.

Routine Maintenance

Routine maintenance must be performed regularly to ensure safe and effective operation. Regularly check the condition of the absorbent and the overall condition of the machine, power cord, hoses, and breathing bag.

Replacing the Absorbent

When the carbon dioxide absorbent in the absorber system is exhausted, it must be replaced. Refer to the manufacturer's instructions for the signs to expect when the absorbent is exhausted.

If the machine has been out of use or in storage, replace the absorbent before using the machine. North American Dräger recommends establishing a routine schedule with a sufficient safety margin for replacing absorbent.

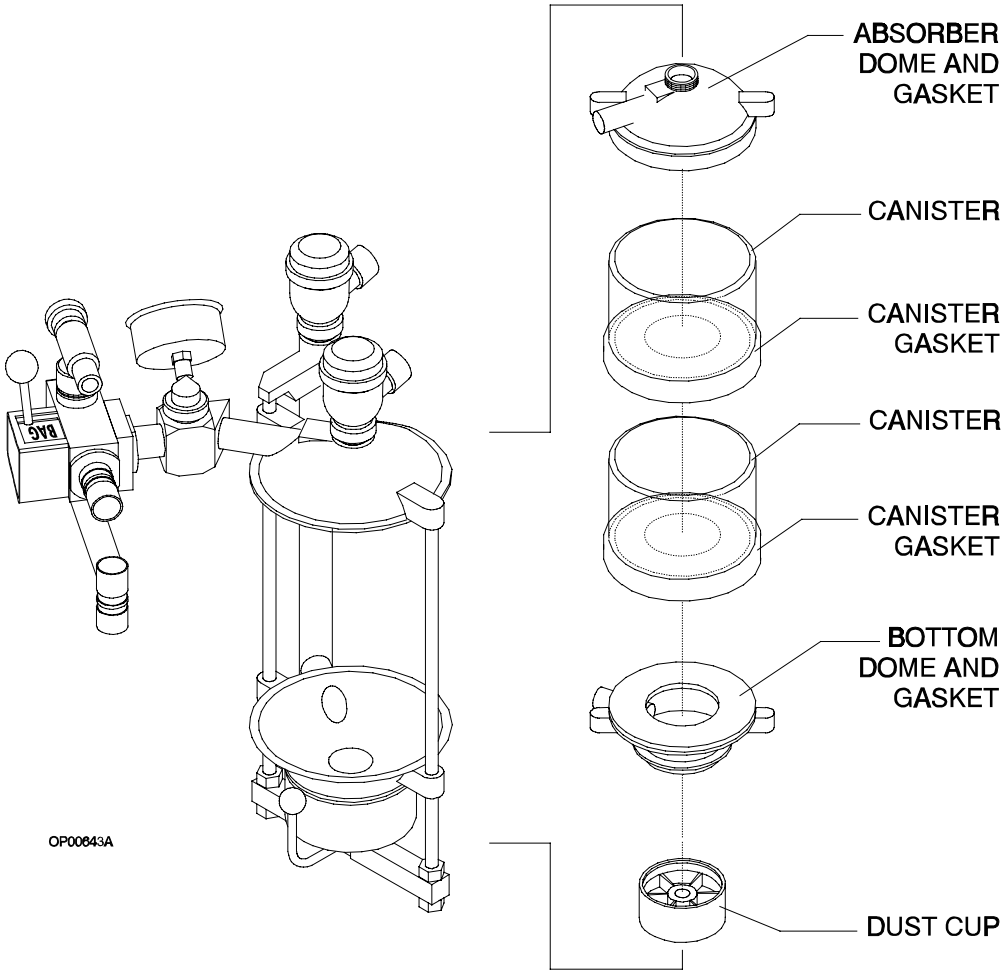
When using loose absorbent, do not fill above the maximum fill level line located about a quarter-inch from the top of the canister. The clearance and the ratio of canister diameter to screen opening minimize the potential for channeling. In channeling, gas flows through the canister along the path of least resistance. The gas depletes the efficiency of the absorbent along this route, bypassing absorbent in the other areas of the absorber.

WARNING: Absorbent is caustic and is a strong irritant to the eyes, skin, and respiratory tract. When replacing the absorbent, take care not to spill its caustic contents.

To replace the absorbent:

1. Pull the canister release lever down.
2. Remove the canisters from the absorber system.
3. Empty the contents of the canisters into an appropriate refuse container.
4. Check the canisters to make sure they are not chipped or cracked.

Section 6
Routine Maintenance and Cleaning



5. Taking care not to chip or crack the canisters, add new absorbent to each one.

   - When using absorbent prepacks, remove all packaging materials (some have clear plastic wrappers) and place a prepack into each canister.

   - When using loose absorbent, fill the canister to the fill line. Do not overfill.

6. Stack one canister on top of the other and center the stack on the gasket of the bottom dome.

7. Raise the bottom dome, remove and empty the dust cup if loose absorbent is present, and replace the dust cup.

8. Pull the canister release lever up to close the absorber system.

9. Perform the absorber portion of the daily checkout procedure provided in the "Daily Checkout" section to verify proper reassembly.

Replacing the Oxygen Sensor

Replace the oxygen sensor capsule when its sensor is depleted, because a depleted sensor cannot correctly analyze oxygen concentrations.

1. Turn the SYSTEM POWER switch to STANDBY.

2. Remove the oxygen sensor housing from the inspiratory valve dome. (It is a press fit.)

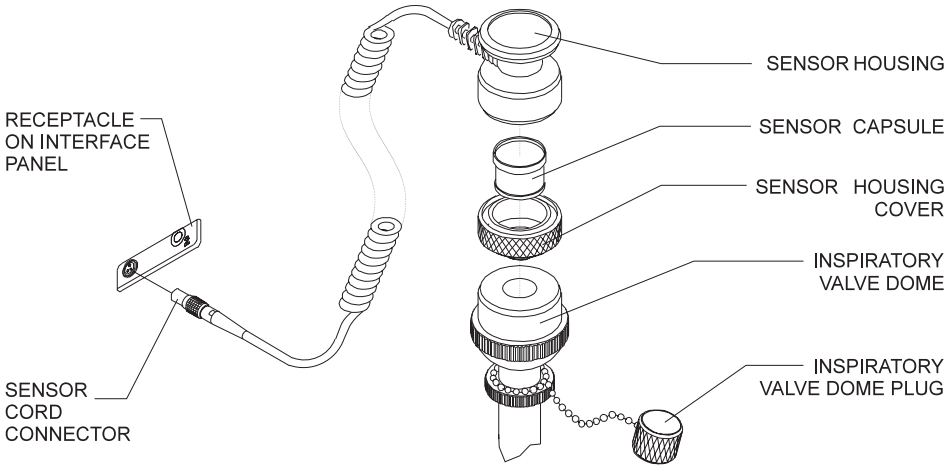
3. Unscrew the cover from the sensor housing and remove the sensor capsule.

4. Install the replacement sensor in the housing. Verify that the copper rings on the capsule mate with the electrical contacts in the sensor housing.

5. Wait 15 minutes to let the sensor capsule stabilize to ambient air.

   If you do not wait, calibration (the next step) will not be successful.

6. Restore power to the machine and calibrate the oxygen sensor, as described in Section 5, "Operation, Oxygen Monitoring."



Section 6
Routine Maintenance and Cleaning

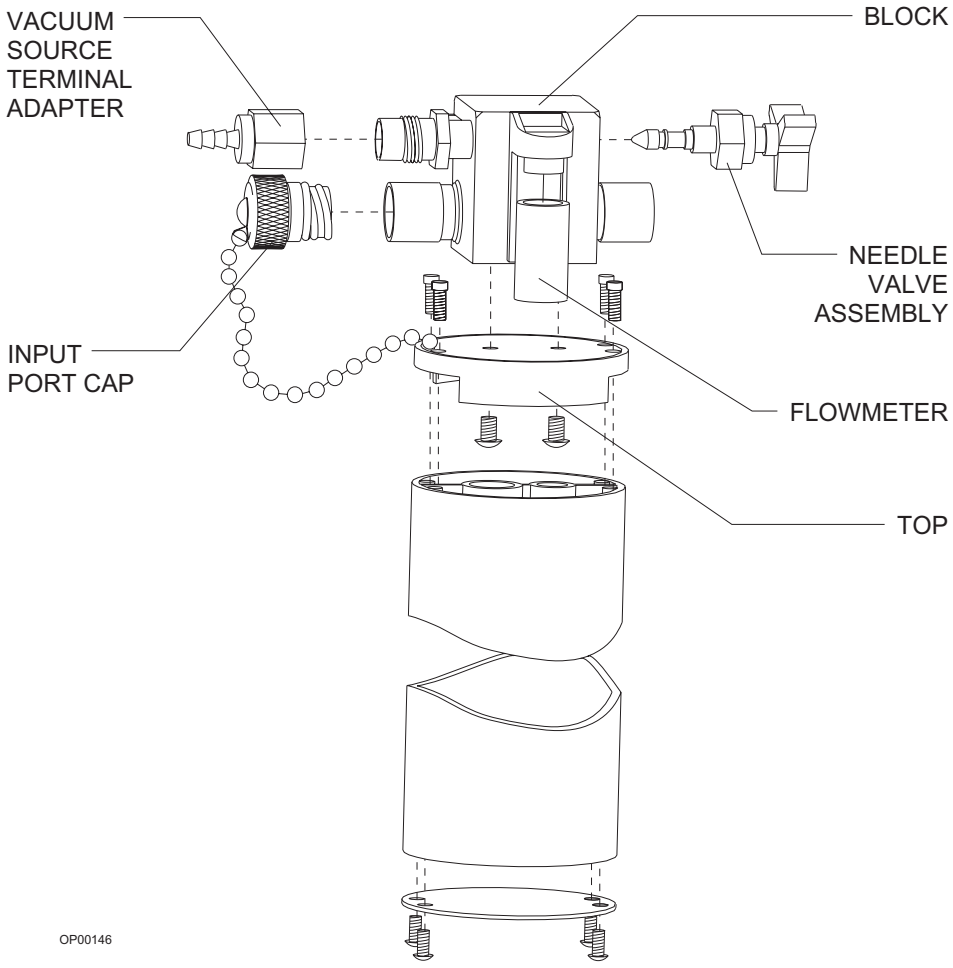
Open Reservoir Scavenger Maintenance

The scavenger should be cleaned at least once every six months.

1. Clean the outer surface of the scavenger with a soft cloth moistened with mild detergent and water.

2. Remove and inspect all scavenger hoses for signs of deterioration. Replace any worn hoses.

3. If applicable, unscrew the wing nut until the needle valve assembly can be removed from its seat. Remove the nut and disassemble the valve. Inspect the needle valve and seat for lint or dust accumulation. Clean with compressed air, if necessary.



4. The flowmeter has a small port, located on its underside, that is open to the atmosphere. For the flowmeter to work properly, this port must remain open. Remove the flowmeter from the block and inspect this port. If it is blocked, clean it with compressed air.

5. Remove the reservoir canister from the scavenger body by unscrewing the four socket head cap screws located at the top of the canister.

6. Replace the cleaned needle valve assembly and reservoir canister. Verify that all parts are completely dry before reassembly.

7. Perform the open reservoir scavenger portion of the daily checkout procedure provided in "Daily Checkout."

Scavenger Interface for Passive Systems Maintenance

The scavenger should be cleaned at least once every six months.

1. Clean the scavenger body with a moist cloth.

2. Inspect all scavenger hoses for deterioration. Replace any worn hoses.

3. Remove the relief valve housing by unscrewing it counterclockwise.

4. Inspect the rubber o-ring. If it is worn, replace it.

5. Remove the relief valve by twisting it counterclockwise out of the housing. You can use the tips of a needle-nose pliers to turn the valve, but take care not to damage the relief valve's fragile valve disk.

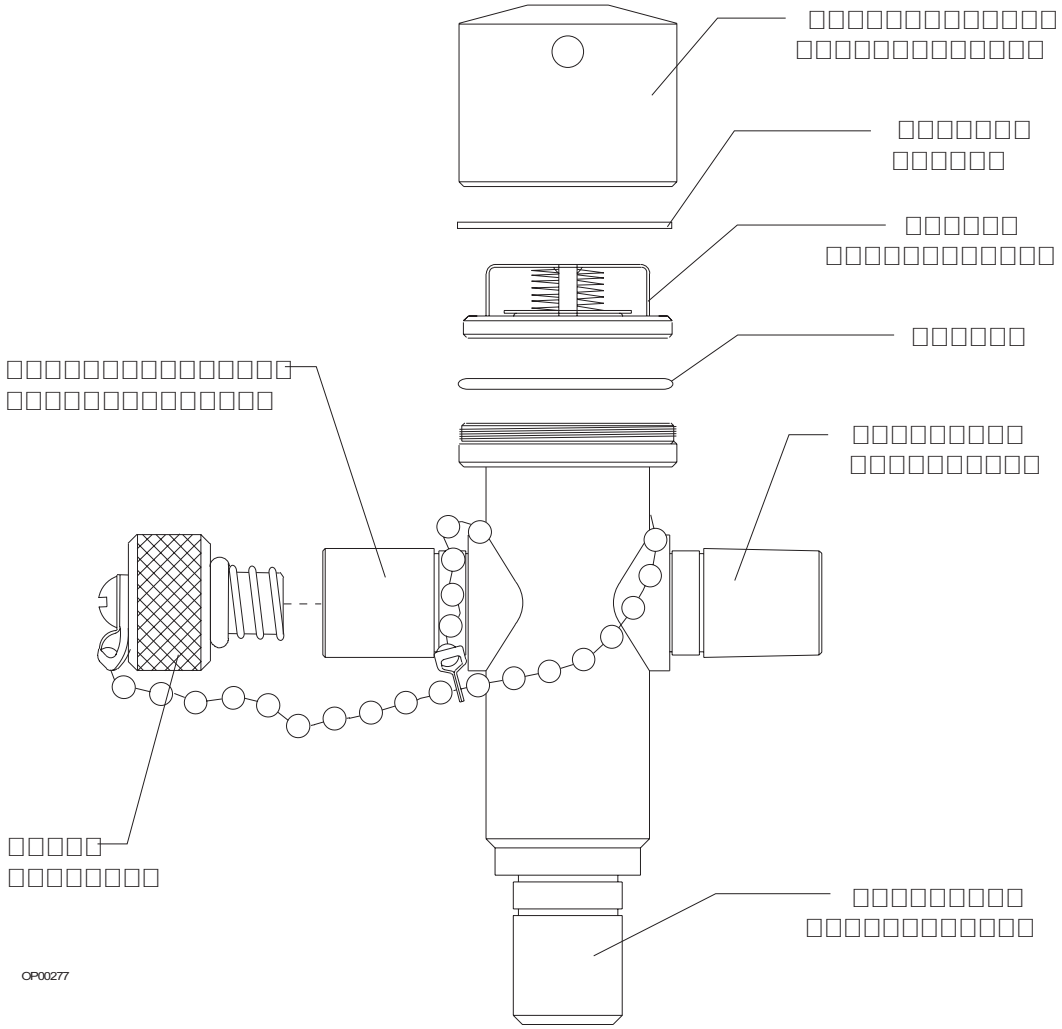
6. Brush any accumulated lint or dust off the valve with a soft brush. The valve can be further cleaned with a low flow of clean air or oxygen.

7. Reinstall the valve into the housing, making sure that it is threaded all the way into the housing and that the plastic washer is properly seated on its upper surface.

8. Verify that the interior of the valve body is completely dry. Reinstall the valve housing onto the scavenger body, making sure that the o-ring is properly seated.

9. Perform the scavenger interface for passive systems portion of the daily checkout procedure provided in "Daily Checkout."

Section 6
Routine Maintenance and Cleaning



Manual Sphygmomanometer Maintenance

Under typical conditions, the only cleaning the manual sphygmomanometer requires is a wiping down with a liquid disinfection agent. However, if further disinfection is required, remove the sphygmomanometer gauge assembly, hoses, and blood pressure cuff from the anesthesia machine and sterilize them with ethylene oxide gas (cold cycle), followed by appropriate aeration according to the sterilizer manufacturer's instructions.

NOTE: Do not autoclave the gauge assembly; it cannot withstand the heat of autoclaving.

Removing Parts for Cleaning and Disinfection

1. Turn the SYSTEM POWER switch to STANDBY.
2. Disconnect the 22 mm breathing circuit hoses between the ventilator and the absorber and from the inspiratory and expiratory valves. Remove the Y-piece, mask, and mask elbow from the hoses.
3. Disconnect the 19 mm scavenger hoses connecting the APL valve to the absorber pole and the ventilator relief valve to the scavenger.

   NOTE: The scavenger interface generally does not need disinfection. However, if your facility requires a disinfection process for the scavenger interface and hoses, remove the scavenger and all 19 mm hoses. Refer back to the cleaning instructions under “Open Reservoir Scavenger Maintenance” or “Scavenger Interface for Passive Systems Maintenance” for disassembly instructions.
4. Remove the oxygen sensor assembly from the inspiratory valve, and disconnect the sensor cord from the system interface panel.
5. Disconnect the respiratory volume sensor cord from the system interface panel.
6. Disconnect the fresh gas hose from the fresh gas outlet.
7. Disconnect the breathing pressure pilot line from the absorber and the system interface panel.

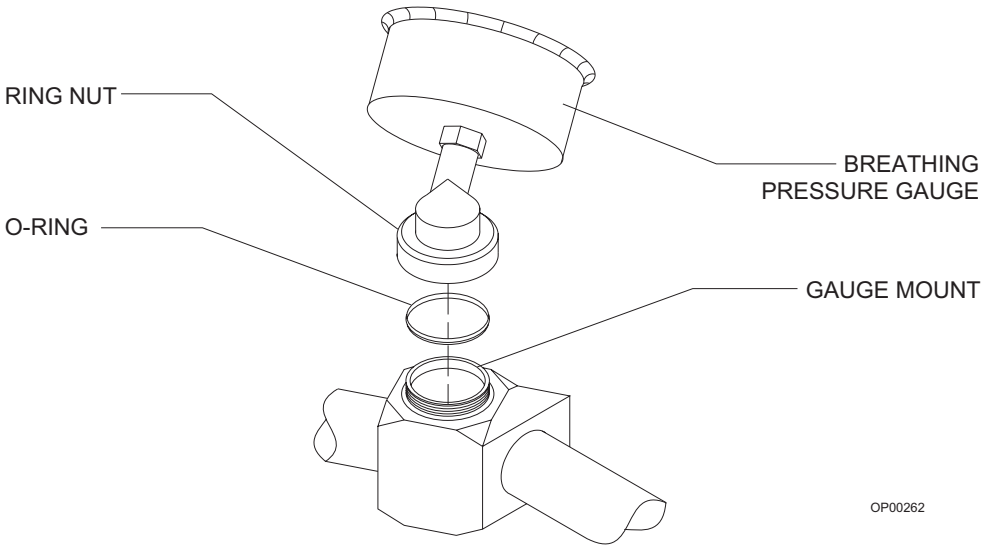
8. Remove the absorbent canisters and dust cup. Discard the absorbent. Refer back to “Replacing the Absorbent” for instructions.

   WARNING: Absorbent is caustic and a strong irritant to the eyes, skin, and respiratory tract. When removing the absorbent, take care not to spill its caustic contents.

9. Remove the inspiratory and expiratory valves by turning their ring nuts counterclockwise until the valves are free of the system.

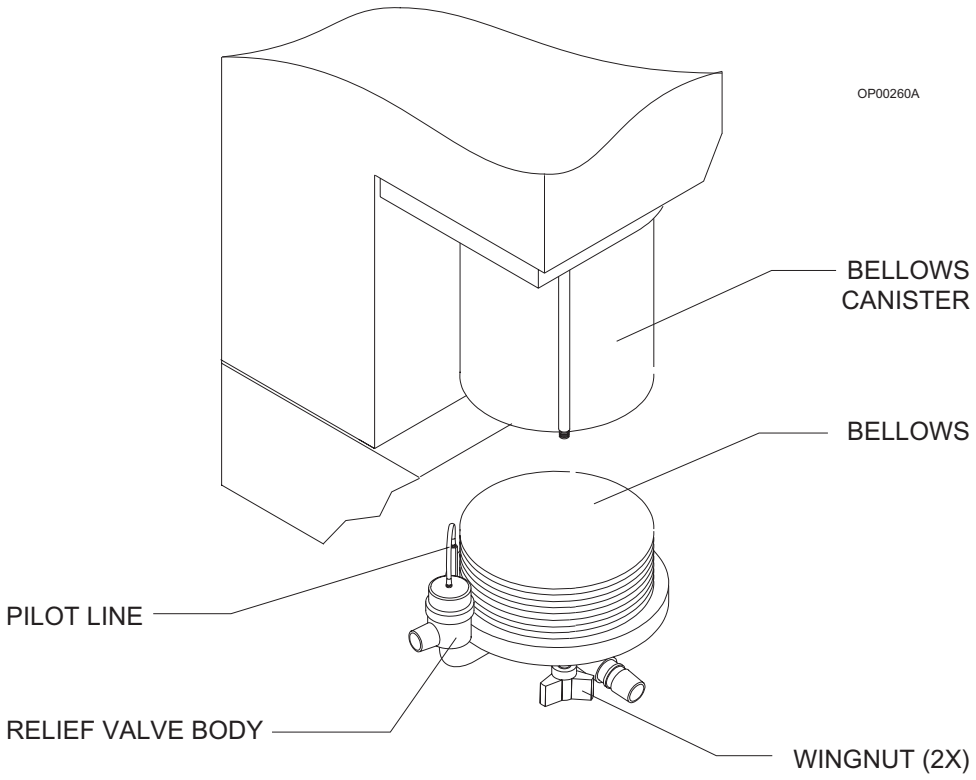
10. Remove the respiratory volume sensor by turning its ring nut counterclockwise until it is free of the absorber dome.

11. Remove the pressure gauge by turning the knurled ring nut that connects the pressure gauge to the gauge mount counterclockwise. Lift the pressure gauge assembly off the gauge mount. Do not misplace the o-ring.



12. Remove the absorber using a 3/16-inch hex screwdriver to loosen the hex screw securing the absorber assembly to the absorber pole. Do not remove the screw. Lift the absorber off the absorber pole. Do not misplace the o-ring.

13. Remove the bellows assembly by loosening the two wing nuts on the bottom of the assembly until the assembly releases from the canister.



Section 6
Routine Maintenance and Cleaning

Disassembling Parts for Cleaning and Disinfection

The following parts must be further disassembled for thorough cleaning and disinfection:

- oxygen sensor assembly
- ventilator bellows assembly
- inspiratory/expiratory valves

Disassembling the Oxygen Sensor Assembly

Unscrew the cover from the sensor housing and remove the sensor capsule. Take care not to drop the sensor housed inside. The sensor is not connected to the housing.

Disassembling the Ventilator Bellows Assembly

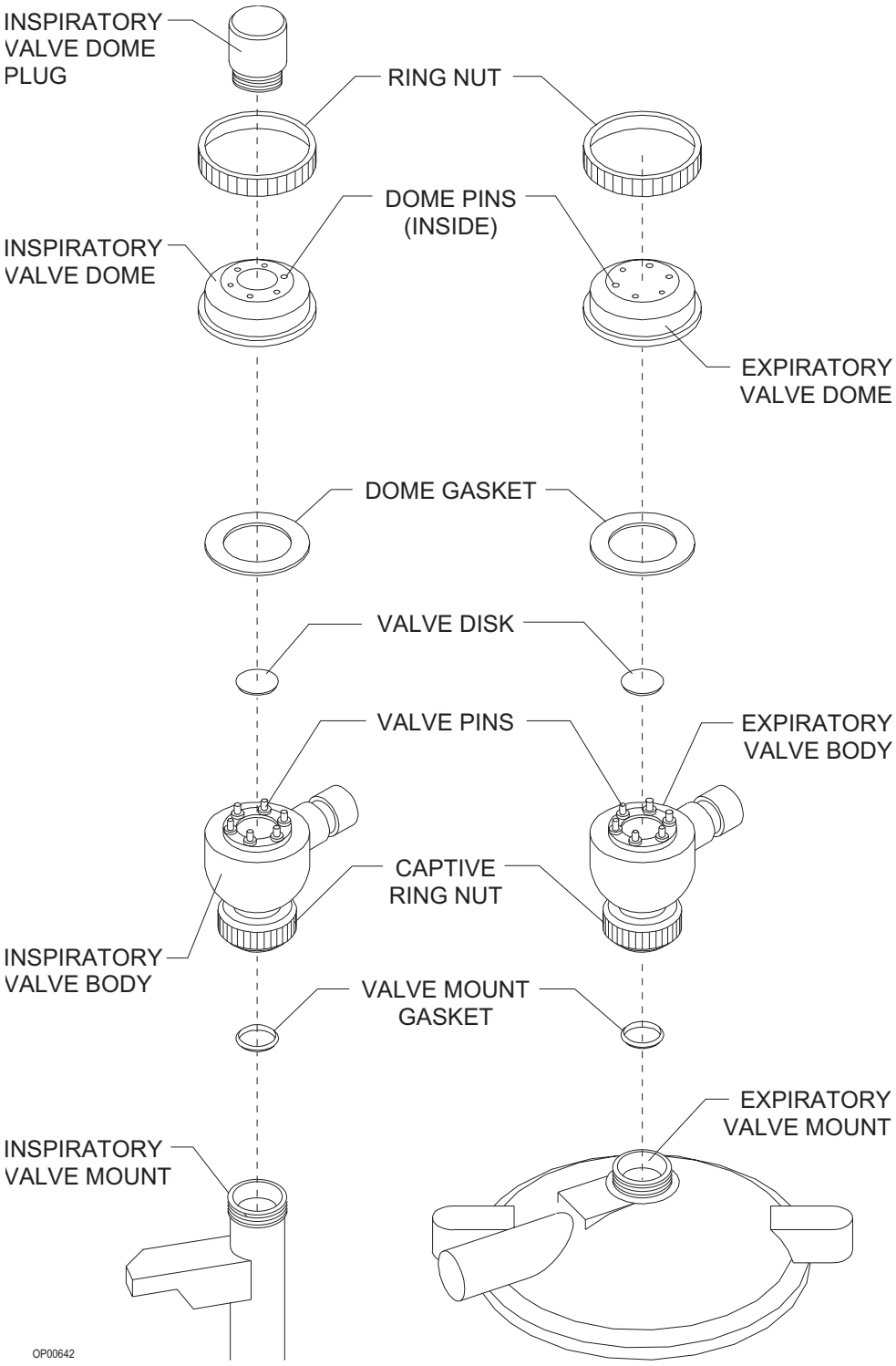
Remove the bellows from the ventilator bottom assembly by unscrewing it in a counterclockwise direction until it is released.

Unscrew the knurled ring nut around the ventilator relief valve and pull the relief valve dome and pilot line away from the relief valve body.

CAUTION: Take special care not to change the position of the adjustment lock ring on the ventilator relief valve dome. Do not attempt to loosen the knurled relief valve ring nut by twisting the pilot line hose barb.

Disassembling the Inspiratory and Expiratory Valves

1. Unscrew and remove the ring nut around the plastic valve dome.
2. Separate the plastic dome, dome gasket, and valve disk from the valve body.


INSPIRATORY VALVE DOME PLUG
RING NUT
DOME PINS (INSIDE)
INSPIRATORY VALVE DOME
EXPIRATORY VALVE DOME
DOME GASKET
VALVE DISK
VALVE PINS
EXPIRATORY VALVE BODY
CAPTIVE RING NUT
INSPIRATORY VALVE BODY
VALVE MOUNT GASKET
EXPIRATORY VALVE MOUNT
INSPIRATORY VALVE MOUNT
OP00642

Section 6
Routine Maintenance and Cleaning

General Guidelines for Cleaning and Disinfection

The frequency, level, and need for disinfection of the Narkomed 2B is determined by the user facility based on the conditions of use and hospital infection control policy. North American Dräger recommends using disposable patient breathing circuits that can be replaced after single use.

If disinfection is required, first clean, dry, and then disinfect the Narkomed 2B and its parts according to the guidelines provided in this chapter. Determining the need and frequency of cleaning or disinfecting any particular component is the responsibility of the user institution. These procedures should be performed according to procedures established by the user institution, following the specific instructions provided by the manufacturer of the equipment or agent used.

For additional information about infection control practice, refer to the *APIC Guideline for Selection and Use of Disinfectants*. This guideline was developed by the Association for Professionals in Infection Control and Epidemiology, Inc. and published in *AJIC* Vol. 24, No. 4 pp. 313-342, August 1996. The following table of recommended disinfection methods for the Narkomed 2B was adapted from the *APIC Guideline for Selection and Use of Disinfectants*.

Part	A	B	C	D	E	F
Exterior Painted, Plated, and Plastic Surfaces					x	x
Corrugated Breathing Hoses, Mask Elbow, and Breathing Bag	x	x	x	x		
Y-Piece and Mask		x	x	x		
Ventilator Bellows		x	x	x		
Ventilator Bellows Bottom Assembly		x				
Oxygen Sensor Capsule		x				
Oxygen Sensor Housing					x	x
Oxygen Sensor Housing Cover		x	x	x		
Inspiratory/Expiratory Valves	x	x	x	x		
Respiratory Volume Sensor		x				
Breathing Pressure Pilot Line		x				
Breathing System Pressure Gauge		x				
Absorber Canisters, Gaskets, and Dust Cup	x	x	x	x		
Vaporizer Exterior					x	x
Corrugated Scavenger Hoses (do not normally need disinfection)	x	x	x	x		
Open Reservoir Scavenger (does not normally need disinfection)		x			x	x
Passive Scavenger Interface (does not normally need disinfection)		x			x	x

A Heat sterilization (autoclaving), including steam or hot air (use manufacturer's recommendations)
B Ethylene oxide gas (use manufacturer's recommendations)
C Glutaraldehyde-based formulations (2%)
D Wet pasteurization at 70° C for 30 minutes after detergent cleaning
E Sodium hypochlorite (5.2% household bleach) 1:500 dilution (100 ppm free chlorine)
F Ethyl or isopropyl alcohol (70% to 90%)

Section 6
Routine Maintenance and Cleaning

CAUTION: To avoid damaging the Narkomed 2B:

- Do not use Betadine®, Povodine®, Sagrotan®, Mucocit®, acetone, ketone, xylene, or anesthetic agents for cleaning.
- Dilute cleaning agents before use by strictly following the manufacturer's instructions.
- Do not use abrasives such as steel wool, liquid abrasives, or powder abrasives on the machine.
- Do not let any liquid enter the interior of the machine.
- Do not submerge any part of the system, unless specifically instructed to do so in this manual.
- Do not pour or spray liquid directly on the machine during cleaning. Always moisten a soft-lint free cloth with the appropriate cleanser before applying it to the machine.
- Wipe any spills and cleanser off the equipment surfaces immediately.

Cleaning and Disinfecting Exterior Surfaces

Clean painted, plated, and plastic surfaces with a soft lint-free cloth moistened with mild detergent and water. Follow up with a 70% to 90% diluted solution of ethyl or isopropyl alcohol or sodium hypochlorite (5.2% household bleach) at 1:500 dilution (100 ppm chlorine).

NOTE: North American Dräger makes no claims about the efficacy of these agents or this method of cleaning for infection control. Consult your hospital's infection control officer or epidemiologist.

Cleaning and Disinfecting Corrugated Breathing Hoses, Mask Elbow, and Bag

Contact with oxygen, ether, mineral or vegetable oils, phenols, cresois, terpenes, hydrocarbon solvents, chlorinated hydrocarbons, esters, or oxidizing acids hastens the deterioration process for rubber goods.

Check the hoses, mask elbow, and breathing bag often for signs of deterioration, including swelling, tackiness, or cracking. Replace the affected parts when any of these conditions are evident.

Thoroughly clean rubber goods with mild alkali detergent and water before disinfecting them. Then, thoroughly rinse them with water to remove all detergent. To prevent water spots, use distilled or demineralized water. Avoid using hard-bristle brushes.

Manufacturers of rubber goods recommend that reusable rubber goods be soaked in a liquid disinfection agent. Always follow the agent manufacturer's instructions for use.

CAUTION: Disinfectants containing phenol or phenyl compounds destroy rubber goods. Latex and rubber goods treated with disinfectants having a quaternary ammonium base will be damaged if subsequently autoclaved.

Use 2% glutaraldehyde-based formulations for more than 20 minutes or wet pasteurization at 70° C for 30 minutes after detergent cleaning.

Thoroughly rinse the corrugated hoses, mask elbow, and breathing bag after contact with chemicals. Use sterilized water to prevent contamination by tap water organisms. Thoroughly dry rubber goods before returning them to service.

The corrugated hoses, mask elbow, and breathing bag can be autoclaved at 121° C. However, such temperatures accelerate the natural aging of rubber goods. Autoclaved rubber goods can also harden over time as a result of the loss of softeners. Exposure to ozone or ultraviolet light also accelerates the natural aging of rubber goods. Reusable rubber goods can also be gas sterilized with ethylene oxide. After EtO sterilization, properly aerate rubber goods before returning them to service. Always follow manufacturer's instructions for these procedures.

CAUTION: Do not autoclave face masks. Autoclaving causes rapid deterioration of face mask cushions.

Cleaning and Disinfecting the Y-Piece and Mask

The Y-piece and mask can be disinfected by wiping or immersion with glutaraldehyde-based formulations. EtO and wet pasteurization processes can also be used.

Cleaning and Disinfecting the Ventilator Bellows

The ventilator bellows and its bottom assembly are the only ventilator components that come in contact with the patient's breath. Refer back to "Cleaning and Disinfecting Exterior Surfaces" for instructions on cleaning and disinfecting the surface of the ventilator bellows assembly.

Clean the bellows with a soft lint-free cloth moistened with mild alkali detergent and water, followed by a distilled water rinse. Let the bellows drip dry.

After cleaning, use wet pasteurization at 70°C for 30 minutes, a gluteraldehyde-based solution, or an EtO process to disinfect the ventilator bellows. Follow manufacturer's guidelines for these procedures.

Section 6
Routine Maintenance and Cleaning

Cleaning and Disinfecting the Ventilator Bellows Bottom Assembly

Clean the ventilator bellows bottom assembly with a soft lint-free cloth moistened with mild detergent and water, followed by a distilled water rinse. Allow the assembly to drip dry.

After cleaning, use an EtO process for disinfection. Follow manufacturer's guidelines.

Cleaning and Disinfecting the Oxygen Sensor Capsule

Wipe the oxygen sensor capsule with a soft lint-free cloth moistened with mild detergent and water. Make sure the capsule is dry before replacing it.

CAUTION: Do not immerse or autoclave the oxygen sensor capsule.

After cleaning the capsule, perform an EtO process at a temperature not exceeding 50°C. Aerate the sensor according to the manufacturer's instructions.

Cleaning and Disinfecting the Oxygen Sensor Housing

The oxygen sensor housing can be immersed for cleaning and disinfection. Use mild detergent and water for cleaning. For disinfection, follow up with either sodium hypochlorite (5.2% household bleach) l:500 dilution (100 ppm free chlorine) or 70% to 90% ethyl or isopropyl alcohol.

Cleaning and Disinfecting the Oxygen Sensor Housing Cover

The oxygen sensor housing cover can be immersed or wiped during cleaning and disinfection. Use mild detergent and water for cleaning. For disinfection, follow up with a 2% glutaraldehyde-based formulation, wet pasteurization at 70°C for 30 minutes, or an EtO process.

Cleaning and Disinfecting the Inspiratory and Expiratory Valves

The inspiratory and expiratory valves come into contact with the patient's breath. Clean these parts with soft lint-free cloth moistened with mild alkali detergent and water. Dry the parts before reassembling.

The valve assemblies can be immersed in a 2% glutaraldehyde-based solution, wet pasteurized, gas sterilized, or autoclaved at a temperature not exceeding 121° C. The valve disks can also be autoclaved in certain instances, but should not be autoclaved routinely.

Be careful while handling the valve disks. Improper handling can damage them. After cleaning or disinfecting the inspiratory or expiratory valve assembly, verify that the valve disk and all internal pins are undamaged and that the valve disks are correctly reinstalled.

Cleaning and Disinfecting the Respiratory Volume Sensor

Clean the sensor after each working day by running distilled water through the housing.

CAUTION: The respiratory volume sensor cannot withstand immersion or the heat and pressure of autoclaving.

After cleaning, dry the sensor with a hose-drying unit or allow it to dry overnight.

The respiratory volume sensor can withstand EtO processes. Use ethylene oxide gas at a temperature not exceeding 50°C. Follow the manufacturer's guidelines for proper aeration.

Cleaning and Disinfecting the Breathing System Pressure Gauge

Wipe the pressure gauge assembly with a soft lint-free cloth moistened with mild detergent and water. Dry the assembly before reinstalling.

The gauge can be disinfected with ethylene oxide gas, followed by appropriate aeration. Follow the manufacturer's instructions.

CAUTION: The breathing system pressure gauge cannot withstand immersion or the heat and pressure of autoclaving.

Cleaning and Disinfecting the Absorber Canister Assemblies and Dust Cup

Refer to the instructions provided earlier in this chapter under the heading, "Replacing the Absorbent" for instructions on removing the absorbent canister assemblies from the absorber.

Clean the canisters frequently. Remove used absorbent and clean absorbent residues for the canister and gasket surfaces. Check the dust cup periodically. Empty and clean it when necessary.

WARNING: Absorbent is caustic. Avoid contact with the skin and eyes.

After removing the canister assemblies and dust cup from the absorber system, wash these parts with mild alkali detergent and water. The canister assemblies and dust cup can be immersed or wiped with a soft lint-free cloth. Allow the parts to dry.

Several methods can be used for disinfection. Wet pasteurization, autoclaving, EtO, and immersion or wiping with 2% glutaraldehyde-based solution are all acceptable. If an EtO process is used, make sure the parts are properly aerated before returning them to service.

Section 6
Routine Maintenance and Cleaning

Cleaning and Disinfecting the Absorber Assembly

Turn the APL valve control knob fully counterclockwise before cleaning or disinfecting the absorber system.

After cleaning, an EtO procedure can be used. Follow manufacturer's guidelines.

CAUTION: Do not autoclave the absorber assembly.

Cleaning and Disinfecting the Vaporizer Exterior

Clean the vaporizer with a soft lint-free cloth moistened with mild detergent and water. Follow up with a 70% to 90% diluted solution of ethyl or isopropyl alcohol or sodium hypochlorite (5.2% household bleach) at 1:500 dilution (100 ppm chlorine). Do not sterilize the vaporizer.

WARNING: Water and other liquids (with the exception of the appropriate anesthetic) that enter the vaporizer chamber can cause injury to the patient or form corrosive products that affect the function of the vaporizer.

CAUTION: Do not immerse the vaporizer or allow water or any other liquid to enter the fill or drain ports or fresh gas inlet or outlet ports. Any vaporizer suspected of contamination with water or any other liquid must be returned to North American Dräger's Technical Service Department for a complete overhaul.

Additional care must be taken with halothane vaporizers. Halothane contains a stabilization additive called thymol, which evaporates more slowly than halothane, and collects in the vaporizer. Over time, thymol may decompose into compounds that affect the wick material and turn the halothane yellow.

If you see particles in the sight glass of a halothane vaporizer, or if the halothane turns yellow, rinse the vaporizer chamber with fresh halothane as follows:

1. Drain the discolored halothane from the vaporizer.

2. Fill the vaporizer with fresh halothane up to the maximum level, then drain completely.

3. Dispose of the drained halothane in accordance with standard practices at your facility.

For information about filling and draining the vaporizer, see Section 5, "Operation - Vaporizer."

Cleaning and Disinfecting the Open Reservoir Scavenger

The scavenger interface does not normally need to be disinfected. However, if the user facility requires disinfection, an EtO process can be used after cleaning. Refer back to the cleaning instructions provided under the “Routine Maintenance“ section in this chapter.

CAUTION: Do not autoclave the open reservoir scavenger. The scavenger’s flowmeter cannot withstand the heat of autoclaving.

Cleaning and Disinfecting the Passive Scavenger Interface

The scavenger interface does not normally need to be disinfected. However, if the user facility requires disinfection, an EtO process can be used after cleaning. Refer back to the cleaning instructions provided under the “Routine Maintenance“ section in this chapter.

CAUTION: Do not autoclave the scavenger interface for passive systems. The scavenger’s relief valves cannot withstand the heat of autoclaving.

Disinfecting the Scavenger Hoses

The scavenger hoses are not part of the breathing circuit, so they do not require disinfection. If the user facility requires disinfection, refer back to the instructions provided in “Cleaning and Disinfecting Corrugated Breathing Hoses, Mask Elbow, and Bag” to select a compatible process.

Check the hoses frequently for signs of deterioration, including swelling tackiness, or cracking. Replace the affected parts when any of these conditions are evident.

Reassembly Instructions

Make sure all parts are complete dry and adequately aerated before reassembling the machine after cleaning and disinfection procedures.

1. Reassemble the ventilator bellows assembly. Fit the relief valve dome onto the relief valve body, and tighten the knurled ring nut. Place the ventilator bellows on bellows bottom assembly and turn it clockwise until it is secure.

2. Replace the bellows assembly. Fit the bellows assembly into the ventilator bellows canister and tighten the two wing nuts.

3. Replace the absorber. Fit the absorber assembly on the absorber pole, making sure the o-ring is in place. Use a 3/16-inch hex screwdriver to tighten the hex screw securing the absorber system assembly to the absorber pole.

4. Replace the pressure gauge. Place the pressure gauge assembly on the gauge mount, making sure that the o-ring is in place between the pressure gauge assembly and the gauge mount. Slide the knurled ring nut over the threads on the gauge mount. Turn the knurled ring nut clockwise until it is secure. Check the gauge needle's zero position and adjust it if necessary.

5. Replace the respiratory volume sensor. Place the sensor on the absorber dome (ensure that the gasket is in place.) Turn the ring nut clockwise until the sensor is secure. Reconnect the sensor cord to the system interface panel.

6. Replace the canisters and dust cup, making sure the gaskets and o-ring are in place. Pull the canister lever up until it clicks in place.

7. Reassemble the inspiratory and expiratory valves. Place the valve disk and dome gasket in the valve body, then replace the dome and ring nut. Turn the ring nut clockwise to tighten.

8. Replace the inspiratory valve assembly and gasket on the valve mount. Turn the valve assembly clockwise to secure it to the valve mount.

9. Replace the expiratory valve assembly and gasket on the respiratory volume sensor. Turn the valve assembly clockwise to secure it to the sensor.

10. Replace the oxygen sensor in the inspiratory valve port. Connect the sensor cord to the system interface panel.

11. Connect the fresh gas hose to the fresh gas outlet on the machine.

    WARNING: Do not pinch or kink the fresh gas hose leading form the fresh gas outlet to the absorber.

12. Reconnect the breathing pressure pilot line to the absorber and the system interface panel.

13. Replace the 22 mm hoses and other breathing circuit accessories.

14. Replace the 19 mm hose that connects the APL valve to the absorber pole.

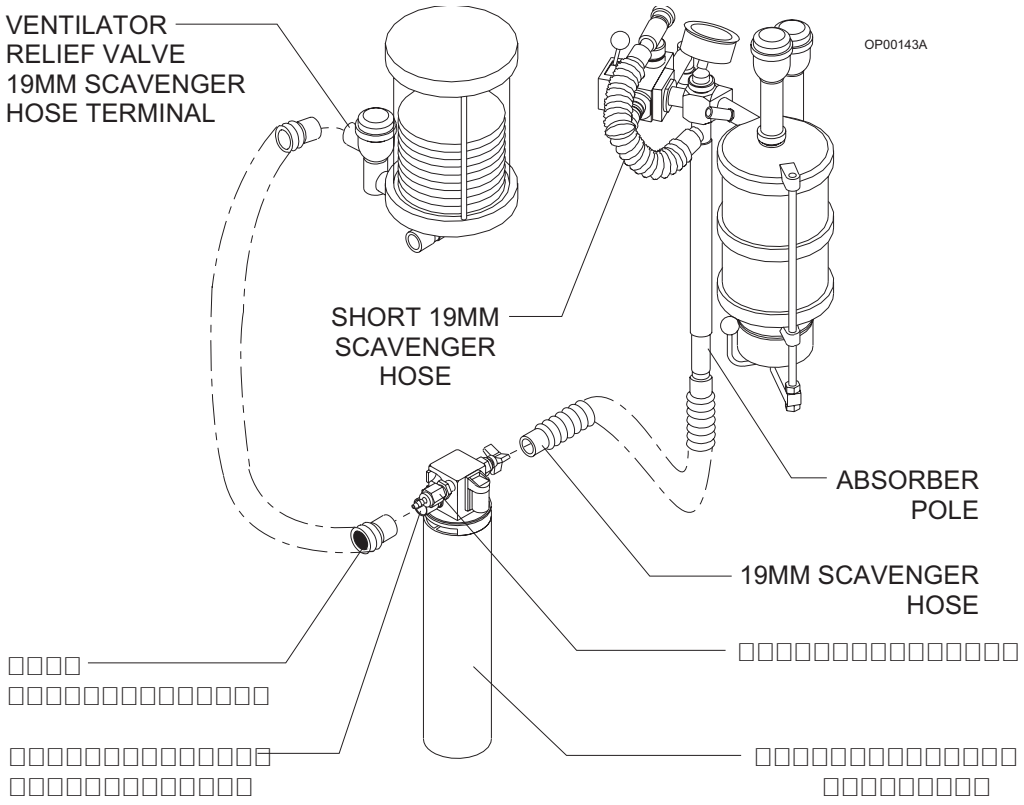
15. Replace the 19 mm hoses that connect ventilator relief valve and absorber pole to the scavenger as illustrated in the following drawings. If the scavenger hoses were removed from the scavenger, replace the scavenger hoses as illustrated on the following pages.

16. Turn the SYSTEM POWER switch to ON.

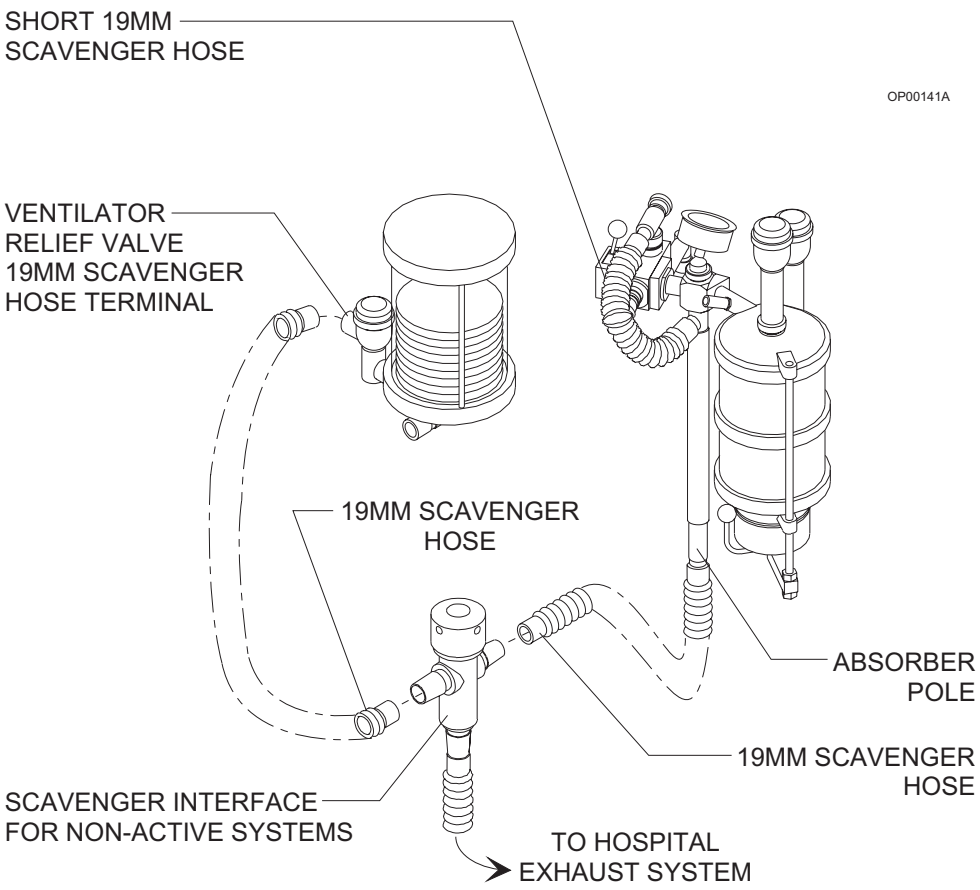
17. Perform the daily checkout procedure provided in this manual before operating the machine.

Section 6
Routine Maintenance and Cleaning

Open Reservoir Scavenger Connections



Passive System Scavenger Connections



RETURN TO CD-ROM TABLE OF CONTENTS

Section 7
Specifications

General

Dimensions (approximate) (W x H x D) . . . . . 32 x 60 1/2 x 27 inches
Weight (approximate) . . . . . 400 lbs

Environmental

Storage

Temperature . . . . . -20–60°C
Humidity . . . . . 10–90% relative humidity (noncondensing)

Operating

Temperature . . . . . 10–40°C
Humidity . . . . . 30–75% relative humidity (noncondensing)

Electrical

Equipment class . . . . . IEC 601 Class 1, Type B
Leakage current . . . . . ≤ 100 microamps
Ground impedance . . . . . ≤ 0.1 ohm (60 Hz source)
Dielectric withstand . . . . . ≥ 1500 VAC (per UL 544)
Chassis resistance (between any metallic point and ground pin on power cord) . . . . . ≤ 0.1 ohm

117 Volt Power Supply

Primary input voltage (acceptable range) . . . . . 90–130 VAC @ 50/60 Hz
Primary input current . . . . . ≤ 6 amps (RMS total)
≤ 1 amps (machine)
≤ 5 amps (receptacles)
Primary input power (includes receptacles) . . . . . ≤ 780 Watts

220/240 Volt Power Supply

Primary input voltage (acceptable range) . . . . . 200–260 VAC @ 50/60 Hz
Primary input current . . . . . ≤ 0.4 amp @ 240 VAC, 50 Hz
Primary input power . . . . . ≤ 104 Watts

Backup Battery

Type . . . . . Sealed lead-acid, maintenance-free
Charging time . . . . . ≤ 16 hours
Reserve power time (from full charge) . . . . . ≥ 30 min

Circuit Breakers

Primary AC power input (machine) 1.0 amp AC (117 VAC power supply)
0.5 amp AC (240 VAC power supply)
Convenience receptacles (117 VAC power supply only) . . . . 5.0 amps AC
Reserve battery power . . . . . 4.0 amps DC

Miscellaneous

Conductive caster resistance . . . . . ≤ 250 kohms

Section 7
Specifications

Gas Delivery System

Pipeline inlet connections	DISS/male Nut with nipple (Canada)
Pipeline inlet pressure	50–55 psi (345–380 kPa) (O_2,N_2O, Air)
Pipeline gauge accuracy	±3 psi (0–25 psi) ±2 psi (25–75 psi) ±3 psi (75–100 psi)
Cylinder connections	Pin-indexed hanger yokes (CGA V-1-1994)
Over pressure relief valve	95 psi (655 kPa)
Over pressure relief valve (Canada)	75 psi (520 kPa) (CSA Standard Z168.3-M84)
Fresh gas common outlet	15 mm female (Canada: 15 mm female, 22 mm male)
Fresh gas oxygen concentration (ORC)	25 ±4%
Oxygen flush flow rate	55 (±10) l/min
Minimum oxygen flow (at 50 psi pipeline pressure)	150 ±50 ml/min
Low oxygen supply pressure alarm	34–40 psi
Cylinder gauge accuracy	±90 psi (0–750 psi) ±60 psi (750–2250 psi) ±90 psi (2250–3000 psi)

Cylinder Gas Pressures (typical full loads at 70°F, 21°C)

Oxygen, Air	1900 psi (13100 kPa)
Nitrous oxide	745 psi (5130 kPa)
Carbon dioxide	838 psi (5770 kPa)
Oxygen-Helium	1900 psi (13100 kPa)

Flowmeter Accuracy (at 20°C and 760 mmHg)

Oxygen, Nitrous Oxide, Air (Fine)	100–1000 ml/min ±2.5% FS
Oxygen, Nitrous Oxide, Air (Coarse)	1–10 l/min ±2.5% FS
Air (Dual Tapered)	0.2–1 l/min ± 50 ml of reading 2–10 l/min ±5% FS
Carbon Dioxide	0.05–1.0 l/min ±5% FS
Oxygen-Helium	2–10 l/min ±5% FS
Oxygen, Nitrous Oxide (Fine) (Optional, Low-Flow)	20–500 ml/min ±2.5% FS
Oxygen, Nitrous Oxide (Coarse) (Optional, Low-Flow)	0.6-10 l/min ±2.5% FS @ >1 l/min ± 15% of reading @ <1 l/min
Oxygen (Auxiliary Oxygen)	0–10 l/min ±5% FS

Vaporizers (Vapor 19.1)

Temperature Range . . . . . +15–35°C (at normal atmospheric pressure of 760 mmHg)
Flow Range . . . . . 0.25-15 l/min
Maximum Pressure Load . . . . . 150 mmHg (above atmospheric)
Maximum Angle of Inclination . . . . . 45°
Weight . . . . . Approximately 7.5 kg

The following values refer to individual concentration settings when operated with a continuous flow of air in the range 0.25–15 l/m, temperature at 22°C, and normal atmospheric pressure (760 mmHg).

Halothane

Adjustment range . . . . . 0.2–5 vol%
Accuracy . . . . . ± 0.15% concentration (volume) **or** ± 15% (whichever is higher)

Enflurane

Adjustment range . . . . . 0.3–7 vol%
Accuracy . . . . . ± 0.2% concentration (volume) **or** ± 20% (whichever is higher) **or** + 20%/- 30% with flow settings 6.0–15 l/min and handwheel settings higher than 5.0% volume concentration

Isoflurane

Adjustment range . . . . . 0.2–5 vol%
Accuracy . . . . . ± 0.15% concentration (volume) **or** ± 15% (whichever is higher)

Sevoflurane

Adjustment range . . . . . 0.3–8 vol%
Accuracy . . . . . ± 0.2% concentration (volume) **or** ± 20% (whichever is higher)

Ventilator

Frequency . . . . . 1–99, ±1 BPM (in 1 BPM increments)
I:E ratio . . . . . *Standard range*: 1:1–1:4.5, ±0.1 (in increments of 0.5); *Extended range*: 4:1, 3:1, 2:1
Inspiratory flow . . . . . 10–100 l/min (uncalibrated)
Tidal volume . . . . . 50–1500 ml, ±100 ml
Pressure limit control adjustment range . . . . . 15–120 cmH_20

Absorber System

Inspiratory Valve

Mounting ring nut size . . . . . M35 x 1
Hose terminal . . . . . 22 mm male

Expiratory Valve

Mounting ring nut size . . . . . M33 x 1
Hose terminal . . . . . 22 mm male

Section 7
Specifications

PEEP Valve (optional)	Range	approx. 2–15 cmH_2O (continuously adjustable)
Breathing System Pressure Gauge	Range	-20 to +80 cmH_2O
	Smallest scale division	2 cmH_2O
	Nominal accuracy	-20 to +5 cmH_2O: 3% FS +5 to +55 cmH_2O: 2% FS +55 to +80 cmH_2O: 3% FS
	Mounting ring nut size	1 1/8 x 18
APL Valve	Nominal low flow resistance	2 cmH_2O at 8 l/min
	Hose terminal	19 mm male
Breathing Bag Terminal	Bag terminal	22 mm male
Oxygen Monitoring	Range	0–100 vol% O_2
	Resolution	1 vol% O_2
	Accuracy	≤ ± 3 vol% O_2 (When calibrated within 18 hours, and constant temperature and pressure)
	Response time	25 sec (T90)
	Zero drift	≤ 0.1 vol% O_2/month
	Span drift	≤ 1 vol% O_2/8 hours
	Temperature error	≤ ± 3% of reading (15° to 40°C)
	Sensor service life	≥8 months at 25°C, 50% relative humidity, 50% O_2 gas mixture (or ≥5000% hour CO_2)
Breathing Pressure Monitoring	Numeric display range	-10–125 cmH_2O
	Resolution	1 cmH_2O
	Accuracy	±3 cmH_2O or ±10% of reading, whichever is greater
	Waveform display scales	0–40, 0–125 cmH_2O
Respiratory Volume Monitoring		
Minute Volume	Display Range	0.1–99.9 l
	Resolution	0.1 l
	Accuracy	≤ +10% or 0.1 l, whichever is greater
Tidal Volume	Display Range	0.05–9.99 l (Note: the standard bellows will deliver up to 1.5 l)
	Resolution	0.01 l
	Accuracy	≤ ±10% or 0.01 l, whichever is greater
	Volume Apnea Threshold	0.05 l

Respiratory Rate	Numeric display range	2–99 BPM
	Resolution	1 BPM
	Accuracy	≤ ±10% or 1 BPM, whichever is greater
Sensor Flow Range		5–100 l/minute

Serial Interface

Serial Ports	Type	RS-232C, DTE
	Baud Rate	300, 2400
	Parity	Odd, Even, None
	Data Bits	7 or 8
	Stop Bits	1 or 2
	Protocols	Vitalink

RETURN TO CD-ROM TABLE OF CONTENTS

Appendix
Spare and Replacement Parts

	Description	Part Number
Manuals	Narkomed 2B Operator's Instruction Manual	4113919
	Narkomed 2B Technical Service Manual	4112817-002
Absorber System	Gasket - Canister Top	4105848
	Gasket - Canister Bottom	4105849
	Gasket - Absorber Bottom	1101001
	Screen - Canister	1100022
	Canister	4105852
	Breathing Pressure Gauge Assembly	4105853
	PEEP Bypass	4110300
	Dome - Inspiratory/Expiratory Valve (without port)	2109230
	Dome - Inspiratory Valve (with sensor port)	4108329
	Plug Assembly - (for inspiratory valve dome with sensor port)	4106837
	Valve Assembly - Inspiratory (with ported dome assembly and plug assembly)	4107649
	Valve Assembly - Expiratory	4107650
	Ring Nut (inspiratory or expiratory valve upper ring nut)	2109228
	Gasket (flat washer, inspiratory or expiratory valve mount)	1101690
	Dust Cup	4106874
	Spring Clip (absorber rod)	1100097
	Hose Assembly (patient pressure/Luer)	4108528
	O-ring #020, Silicone (absorber mount)	4105868
	O-ring #237, Silicone (dust cup fitting)	4102940
Breathing System Accessories	Breathing Hose, 22 mm x 23" long	9995123
	Breathing Hose, 22 mm x 32" long	9995132
	Breathing Hose, 22 mm x 40" long	9995140
	Rubber Good Set (includes Y-Piece, Mask Elbow, 2 Liter Breathing Bag, and 2 each 32" Breathing Hoses	1101071
Gas Evacuation Accessories	Hose, 19 mm x 10" long	9995210
	Hose, 19 mm x 20" long	9995220
	Hose, 19 mm x 30" long	9995230
	Hose, 19 mm x 48" long	9995248
Breathing Bags	2.0 liter	9995320
	5.0 liter	9995350

Appendix
Spare and Replacement Parts

	Description	Part Number
Vaporizers 19.1	Mounting screws (4 x 30 metric)	HW01072
	O-rings	2121929
	Cover assembly vapor block (short circuit block)	4104530
Bellows	Adult Latex-Free Bellows (replacement bellows)	4106930
	Pediatric Bellows	4109700
Oxygen Monitoring Accessories	Oxygen Sensor Capsule	6803290
	Sensor Housing & Cable Assembly	4106363
	Inspiratory Valve Dome	4108329
	Inspiratory Valve Dome Plug	4106387
Breathing Pressure Monitoring Accessories	Breathing Pressure Pilot Line (to absorber)	4109368
	Breathing Pressure Pilot Line (with Luer to Y-piece)	4108528
Respiratory Volume Monitoring Accessories	Volume Monitor Sensor Assembly	4106362
	Volume Sensor Lubrication Kit (supplied with Sensor Assembly)	2218180
	Gasket (expiratory valve mount and sensor inlet)	1101690
Communication Cables	DB9/DB25/2.5 ft for 9 to 25 pin adapter	4109882
	DB9/DB9/2.5 ft for use with Vitalink	4110328
	DB9/DB25/10 ft for link to printer	4110568
	DB15/DB15/2 ft for network data loop	4112349

Index

A

Absorbent replacement 6-1
Absorber system 2-12
AC power failure indicator 2-20
Advisories
  breathing pressure 5-12-10
  display area 2-26
  oxygen 5-10-7, 5-10-9
  power failure 2-23
  respiratory volume 5-11-5
  speaker failure 2-27
Alarm limits
  high pressure 5-12-6
  minute volume 5-11-3, 5-11-4
  oxygen concentration 5-10-4
  threshold pressure 5-12-7
Alarms
  battery failure 2-24
  breathing pressure 5-12-10
  display area 2-26
  oxygen 2-5, 2-21, 5-10-9
  power failure 2-23
  respiratory volume 5-11-3, 5-11-5
  silencing 5-9-6
  speaker failure 2-27
Auxiliary oxygen flowmeter 2-11

B

Bain circuit adapter 2-15
Battery
  backup system 2-23
  machine functions 2-23
  test 5-7-2
Breathing pressure monitoring
  adjusting alarm limits 5-12-6, 5-12-7
  alarm summary 5-12-10
  apnea alarm disable key 5-12-9
  breathing rate 5-12-4
  measuring the pressure 5-12-1
  numerical data 5-12-5
  pilot line installation 5-12-2
  problem resolution 5-12-11
  trace data 5-12-4
  trend data 5-12-4
  waveform display 5-9-7, 5-12-4
Breathing System Pressure Gauge 2-14

Index

C

Calibrating the oxygen sensor 5-10-5, 5-10-7
Canisters, absorber 2-14
Cautions
  battery failure 2-24
  breathing pressure 5-12-10
  display area 2-26
  oxygen 2-5, 2-21, 5-10-9
  respiratory volume 5-11-5
Central alarm annunciation 2-26
Checkout procedure
  daily 3-1
  preuse 4-1
Circuit breakers 2-23
Cleaning and disinfecting 6-12
Color coding 2-2
Configure
  keys 5-9-5
  screen 5-9-4
Convenience receptacles 2-22
Cylinder connections 5-1-2

D

Disassembling parts for cleaning and disinfection 6-10
Display screen
  left-hand 2-25, 2-26
  right-hand 2-26

E

Exclusion system, vaporizer 2-11, 5-2-2

F

Flow control valves 2-6
Flowmeters 2-6
Frequency control 5-8-4
Fresh gas
  hose connection 5-1-4
  outlet 2-8
  oxygen sensor adapter 2-10

G

Gas delivery system
  general description 2-1
  operation 5-1-1
Gases 2-1
Guidelines for cleaning and disinfection 6-12

I

Inspiratory flow control 5-8-5
Inspiratory/Expiratory Phase Time Ratio 5-8-5
Inverse ratios 5-8-5

K

Keys
- apnea alarm disable 5-12-9
- configure 5-9-5
- control 5-9-2
- high pressure alarm limit 5-12-6
- minute volume alarms 5-11-3
- oxygen alarms 5-10-3
- pressure alarms 5-12-6
- threshold pressure alarm limit 5-12-7
- trace 5-12-4
- volume alarms disable 5-11-4

L

Left-hand screen 5-9-2
Low oxygen supply whistle 5-10-10
Low-flow flowmeters 2-6

M

Main switch panel 2-20, 5-7-1
Manual sphygmomanometer 5-13-1
Manual sphygmomanometer maintenance 6-6
Minimum oxygen flow 2-6
Minute volume 5-11-2
Monitor
- control keys 2-26, 5-9-2
- screens 5-9-2

Monitoring system
- general description 2-25
- operation 5-9-1

N

Numerical data 5-9-3, 5-9-10
- breathing pressure 5-12-5
- oxygen concentration 5-10-3
- respiratory volume 5-11-2

O

O.R. Data Manager 2-28
Open reservoir scavenger maintenance 6-4
Optional gases 2-1
Oxygen analysis
- adjusting alarm limits 5-10-4
- alarms summary 5-10-9
- measuring the concentration 5-10-1
- numerical data 5-10-3
- problem resolution 5-10-11
- sensor calibration 5-10-5, 5-10-7
- trend data 5-10-2

Index

Oxygen flush 2-7, 5-1-4
Oxygen ratio controller 2-7
Oxygen sensor
  calibration 5-10-5, 5-10-7
  cleaning 6-4
  replacement 6-3
Oxygen supply low whistle 5-10-10
Oxygen supply pressure failure protection device 2-5

P

Passive systems scavenger maintenance 6-5
Pipeline connections 2-2, 5-1-1
Power
  supply 2-22
  switch 5-7-1
Power-On initialization 5-9-1
Pressure gauges
  cylinder 2-5
  pipeline 2-2
Preuse checkout procedure 4-1
Problem resolution
  breathing pressure monitoring 5-12-11
  oxygen analysis 5-10-11
  respiratory volume monitoring 5-11-7

R

Removing parts for cleaning and disinfection 6-7
Respiratory rate 5-11-2
Respiratory frequency 5-8-4
Respiratory volume monitoring
  adjusting the minute volume low alarm limit 5-11-4
  alarm summary 5-11-5
  measuring the volume 5-11-1
  numerical data 5-11-2
  problem resolution 5-11-7
  trend data 5-11-2
Right-hand screen 5-9-3
Routine maintenance 6-1

S

Scavenger
  interface for passive systems 2-18, 5-6-1
  open reservoir 2-17, 5-5-1
Screen
  Configure 5-9-4
  left-hand 2-25, 2-26, 5-9-2
  power-on 5-9-1
  right-hand 2-26, 5-9-3
self-tests 5-9-1

Serial port 5-9-4
Sphygmomanometer 2-27, 5-13-1
Standard gases 2-1
Sterilization 6-12
System
control keys 2-25
interface panel 2-24
power switch 2-20, 5-7-1

T

Tidal volume display 5-11-2
Tidal volume adjustment 5-8-4
Trace data 5-9-2, 5-9-7, 5-12-4
Trend data 5-9-2, 5-9-8
breathing pressure 5-12-4
oxygen concentration 5-10-2
respiratory volume 5-11-2

V

Vaporizer
general description 2-11
operation 5-2-1
Ventilator
general description 2-19
operation 5-8-1

W

Warnings
breathing pressure 5-12-10
display area 2-26
oxygen 5-10-9
respiratory volume 5-11-5

Y

Yokes 2-4, 5-1-2

RETURN TO CD-ROM TABLE OF CONTENTS

RETURN TO CD-ROM TABLE OF CONTENTS

RETURN TO CD-ROM TABLE OF CONTENTS

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